Alaska Fisheries Data Series Number 2004-6

Abundance and Run Timing of Adult Pacific Salmon in the Tuluksak River, Yukon Delta National Wildlife Refuge, Alaska, 2003

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September 2004

United States Department of the Interior
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By

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The Alaska Fisheries Data Series was established in 1994 to provide public access to unpublished study results. These reports are intended to document short-term field studies limited in or lacking statistical interpretation. Reports in this series receive limited internal review prior to release and may be finalized in more formal literature in the future. Consequently, these reports should not be cited without approval of the author or the U.S. Fish and Wildlife Service.

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Abstract.—A resistance board weir was used to collect abundance, run timing, and biological data from salmon returning to the Tuluksak River, a tributary to the lower Kuskokwim River, between June 16 and September 14, 2003. Data collected were used in-season to manage the commercial and subsistence fisheries in the Kuskokwim area.

A total of 11,625 chum *Oncorhynchus keta,* 1,064 chinook *O. tshawytscha*, 282 sockeye *O. nerka*, 637 pink *O. gorbuscha* and 39,627 coho salmon *O. kisutch* were counted through the weir during 2003. Peak weekly passage occurred July 27 to August 2 for chum, June 29 to July 5 for chinook, July 6 to 12 for sockeye, July 13 to 19 for pink, and August 24 to 30 for coho salmon.

A flooding event in 2003 prevented accurate counts from August 16 to 18. Escapement estimates during the flood, based upon historical proportional passage from the same time period, accounted for less than 1% of the return for each species. Estimated total escapement was 11,724 chum, 1,064 chinook, 288 sockeye, 662 pink, and 41,071 coho salmon. Run timing was late for chum salmon, early for chinook, and average for sockeye, pink and coho salmon.

Age, sex, and length data were collected from 1,234 chum salmon, 253 chinook salmon, 52 sockeye salmon, and 217 coho salmon. Four age classes were identified for chum salmon, five for chinook, three for sockeye, and three for coho salmon. It was estimated that female chum salmon made up 33% of the chum run, female chinook salmon made up 27% of the chinook run, and female coho salmon made up 52% of the coho run. In sampled fish, male chum salmon were larger than females for ages 0.3 and 0.4 fish and there was a significant difference in age composition between sexes. Female chinook salmon were larger than males for age class 1.3 and 1.4 fish, and there was a significant difference in the age composition between sexes. Coho salmon age compositions did not differ between sexes while mean lengths for 2.1 and 3.1 coho salmon did not differ between sexes.

In addition to salmon, nine Dolly Varden *Salvelinus malma*, 79 whitefish *Coregonus* and *Prosopium* spp., two northern pike *Esox lucius*, and 120 Arctic grayling *Thymallus arcticus* were counted through the weir.

Introduction

The Tuluksak River, located approximately 218 river kilometers (rkm) upstream from the mouth of the Kuskokwim River, Alaska, flows through the Yukon Delta National Wildlife Refuge (Refuge) and supports spawning populations of chinook, chum, pink, coho, and a small population of sockeye salmon. These salmon contribute to large subsistence and commercial fisheries in the lower Kuskokwim River drainage. In addition to human consumption, salmon provide food for brown bears and other carnivores, raptors and scavengers. These salmon also sustain resident fish species and salmon fry that rely heavily on the nutrient base provided by salmon carcasses (U.S. Fish and Wildlife Service 1992).

The salmon fishery in the Kuskokwim River drainage is managed under the Kuskokwim River Salmon Rebuilding Management Plan (Rebuilding Plan) (5AAC 07.365). The portion of the Kuskokwim River within the boundaries of the Yukon Delta National Wildlife Refuge was under both the Rebuilding Plan and subsistence fishery management by federal managers. The Alaska Department of Fish and Game (Department), the U.S. Fish and Wildlife Service (Service), and the Kuskokwim River Salmon Management Working Group (Working Group) work together to achieve the goals of both plans. The Rebuilding Plan was established to provide management guidelines resulting in the sustained yield of salmon stocks large enough to meet the following goals: (1) To manage for the achievement of established escapement goals; (2) To meet the amounts necessary for subsistence; (3) To allow for a commercial fishery on harvestable surplus after escapement and subsistence needs are projected to be met (Ward et al. 2002). In addition to the goals set by the Department, the Service, and the Working Group, the Alaska National Interest Lands Conservation Act (ANILCA) mandates that salmon populations and their habitats be conserved in their natural diversity within the Yukon Delta National Wildlife Refuge.

To manage for sustained yields and conservation of all individual salmon stocks, managers need escapement data and migratory timing of individual stocks accompanied by sex and age composition throughout the migratory period. Managing for all individual salmon stocks can be difficult since salmon stocks are mixed during the annual migration up the Kuskokwim River, increasing the potential for smaller salmon stocks to be over harvested during periods of commercial and subsistence fishing. Therefore, area managers attempt to conserve these smaller salmon stocks by distributing harvest throughout the entire salmon run.

In previous years, salmon escapements were monitored using aerial index surveys and a resistance board weir in the Tuluksak River. Aerial index surveys started in 1965 and occurred sporadically until 1997. These surveys however, were infrequently used for in-season management of the Kuskokwim River fishery because the surveys often occurred after the commercial fishing season.

In order to obtain salmon escapement data, a resistance board weir was used in the Tuluksak River between 1991 and 1994, and between 2001 and 2003. A weir was not operated on the Tuluksak River between 1995 and 2000.

In 2001, the Service and the Village of Tuluksak initiated a cooperative escapement monitoring project to meet the goals of the Service, Department, Working Group and the mandates of ANILCA. The project objectives are to: (1) count the daily passage of chinook, chum, pink, sockeye, and coho salmon and resident fish species through a weir on the Tuluksak River; (2) describe run-timing using daily passage counts of chinook, chum, pink, sockeye, and coho salmon passing through the weir; (3) estimate weekly age and sex composition of chinook, chum, sockeye, and coho salmon passing through the weir; (4) determine the length of chinook, chum, sockeye, and coho salmon by age and sex; (5) enumerate chinook, chum, pink, sockeye, and coho salmon carcasses washing onto the weir each day. These data will aid the in-season management of the Kuskokwim River subsistence and commercial fisheries.

Study Area

The Tuluksak River is one of several tributaries flowing into the lower Kuskokwim River and is located approximately 93 rkm northeast of Bethel, AK. The Tuluksak River is approximately 137 rkm in length and its watershed encompasses roughly 2,098 km^2 (Tobin 1994; Harper 1997) (Figure 1). It originates in the Kilbuck Mountains and flows to the northwest. The Fog River drains into the lower portion of the Tuluksak River and is the only major tributary. The Tuluksak River is a slow moving river for the majority of its length and is characterized by dense overhanging vegetation and cut banks. The lower portion of the river is characterized by low-gradient, silty substrate and turbid waters. The river section at the weir site, approximately 49 rkm from the mouth, is 42 meters wide, shallowest in mid-river and deepest near the banks. The substrate contains primarily sand mixed with fine gravel. Water clarity is moderately clear but can become turbid during rainy periods and when boat traffic is present.

Methods

Weir Operations

A resistance board weir (Tobin 1994) was installed in 2003 in the Tuluksak River at rkm 49 (61°02.641') (W160°35.049'). This location is approximately 16 rkm downstream from the previous weir site used between 1991 and 1994 (Harper 1995 a,b,c; Harper 1997). The weir was relocated to a position below known salmon spawning grounds. The lower site also provides easier boat access to the weir during low water conditions.

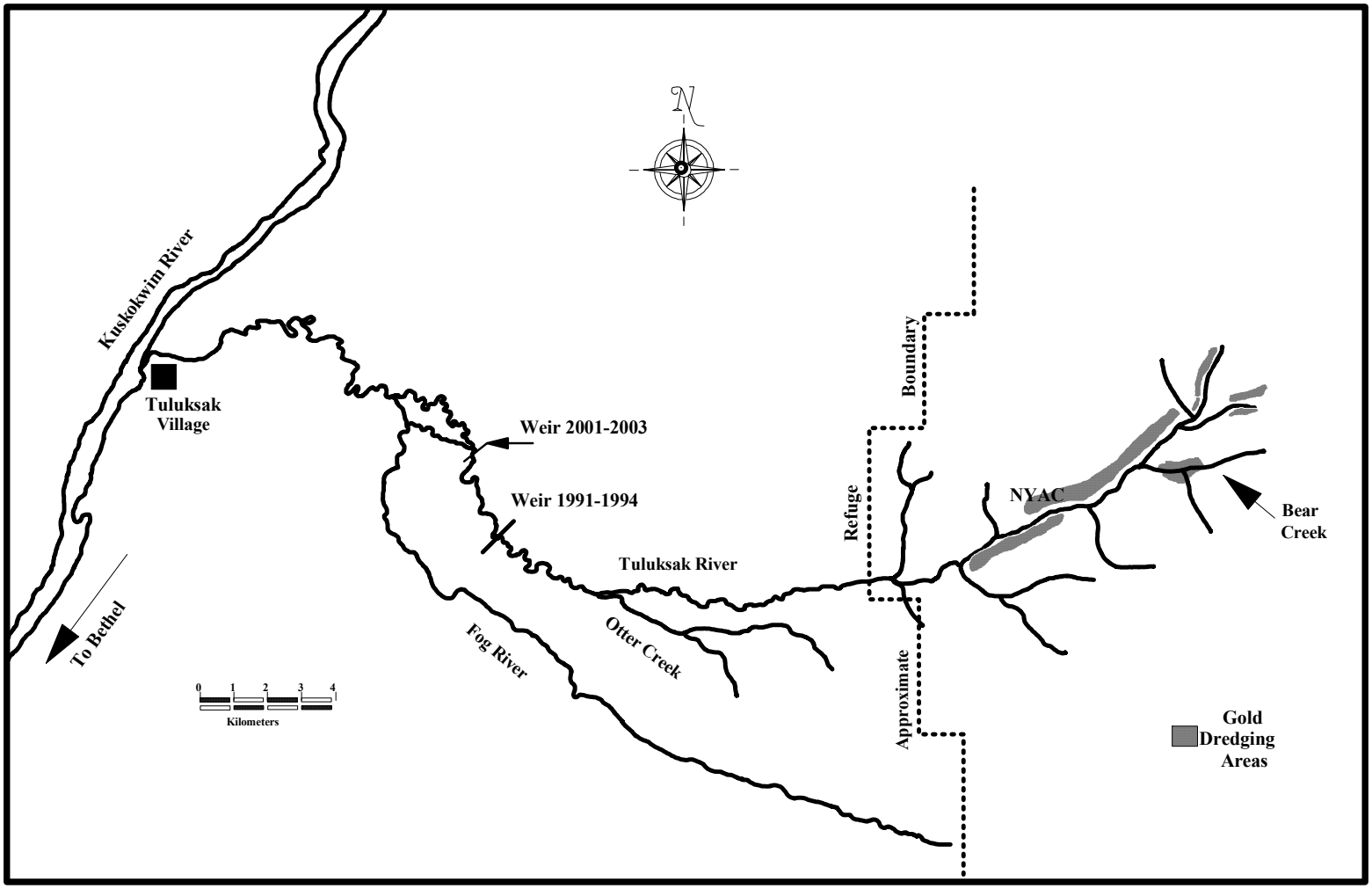

FIGURE 1. —Tuluksak River weir location, Yukon Delta National Wildlife Refuge, Alaska, 1991-1994, and 2001-2003.

This weir was modified slightly from the previous weir design used between 1991 and 1994 (Tobin 1994). A range of modifications took place in 2001 to increase efficiency of installation, operations, and takeout, and increase the efficiency of fish passage (Gates and Harper 2002).

Two passage panels were installed, both with an attached live trap. Counts started at approximately 0700 hours every day and continued until visibility was too poor to identify salmon by species. All passing salmon and resident fish were identified to species and recorded. During periods when the weir was submerged, the traps were left open to allow salmon and resident fish to pass freely. For those days, salmon escapement was estimated using the average proportion of fish passing in previous years for those individual days (Harper 1997).

A stream gauge was installed near the shore on the river right bank approximately 10 meters downstream of the weir. The stream gauge (cm), was read twice daily and noted in the field log. To compensate for the placement of the stream gauge and to have it more accurately reflect the water depth across the river, an average water depth and stream gauge reading were taken simultaneously post installation. Water depth was later converted to metric units. Water temperatures were recorded using an ONSET, Optic StowAway ®Temp logger**.** The temperature logger was programmed to record a temperature reading every 30 minutes and was placed in a location not affected by daily fluctuations of surface temperatures. The Temp logger was downloaded once at the end of the season. Temperature data were then averaged for each day.

Biological Data

Statistical weeks started on a Sunday and continued through the following Saturday (Harper 1997). Target sample size consisted of 210 chum and chinook salmon each week. The coho salmon sample, obtained at only three different time periods during the run, consisted of 70 fish per sample. Sockeye salmon were sampled on an opportunistic basis. Biological sampling occurred between Monday and Thursday of each statistical week in order to obtain a snapshot sample (Geiger et al. 1990). Once the quota was met for a particular species, sampling would stop for that species and continue for others but typically would not extend past Thursday.

Age, sex, and length data were collected from each sampled chum, chinook, sockeye, and coho salmon. Sampled fish were caught using the live trap attached to each passage chute. A fyke gate, installed on the entrance of each trap, allowed fish to enter and at the same time minimized the number of fish exiting the trap downstream. Sampling occurred when approximately 40 fish were in the trap. Four scales were extracted from chinook and coho salmon and one was extracted from chum and sockeye salmon for age determination. All scales were taken from the preferred area using methods described by Koo (1962) and Mosher (1968). Sex was determined by observing external characteristics, and length was measured from the mid-eye to the fork of the caudal fin to the nearest 5 millimeters. All data was recorded and then transferred to mark-sense

forms at the end of each sample day. Mark-sense forms were processed by the Department when the aging and impression process was completed.

Ages for salmon were reported according to the European Method (Koo 1962) where numerals preceding the decimal denote freshwater annuli and numerals following the decimal denote marine annuli. Total years of life at maturity is determined by adding one year to the sum of the two digits on either side of the decimal of the European designation (i.e. age 1.4 and 2.3 (1.4=1+4+1=6 and 2.3=2+3+1=6) are both six-year-old fish from the same parent year). The parent year is determined by subtracting fish age from the current year.

Characteristics of fish passing through the weir were estimated using standard stratified random sampling estimators (Cochran 1977). Within a given stratum m, the proportion of species i passing the weir that are of sex j and age k (p_{ijkm}) was estimated as

$$\hat{p}_{ijkm} = \frac{n_{ijkm}}{n_{i++m}},$$

where n_{ijkm} denotes the number of fish of species i, sex j, and age k sampled during stratum m and a subscript of "+" represents summation over all possible values of the corresponding variable, e.g., n_{i++m} denotes the total number of fish of species i sampled in stratum m. The variance of $\hat{p}_{ijkm}$

was estimated as

$$\hat{v}\left(\hat{p}_{ijkm}\right) = \left(1 - \frac{n_{i++m}}{N_{i++m}}\right) \frac{\hat{p}_{ijkm}\left(1 - \hat{p}_{ijkm}\right)}{n_{i++m} - 1},$$

where N_{i++m} denotes the total number of species i fish passing the weir in stratum m. The estimated number of fish of species i, sex j, age k passing the weir in stratum m (N_{ijkm}) is

$$\hat{N}_{ijkm} = N_{i++m}\,\hat{p}_{ijkm},$$

with estimated variance

$$\hat{v}\left(\hat{N}_{ijkm}\right) = N_{i++m}^{2}\,\hat{v}\left(\hat{p}_{ijkm}\right).$$

Estimates of proportions for the entire period of weir operation were computed as weighted sums of the stratum estimates, i.e.,

$$\hat{p}_{ijk} = \sum_m \left(\frac{N_{i++m}}{N_{i+++}} \right) \hat{p}_{ijkm}$$

with estimated variance

$$\hat{v}\left(\hat{p}_{ijk}\right) = \sum_m \left(\frac{N_{i++m}}{N_{i+++}} \right)^2 \hat{v}\left(\hat{p}_{ijkm}\right).$$

The total number of fish in a species, sex, and age category passing the weir during the entire period of operation was estimated as

$$\hat{N}_{ijk} = \sum_m \hat{N}_{ijkm} ,$$

with estimated variance

$$\hat{v}\left(\hat{N}_{ijk}\right) = \sum_m \hat{v}\left(\hat{N}_{ijkm}\right).$$

If the length of the r^{th} fish of species i, sex j, and age k sampled in stratum m is denoted x_{ijkmr}, the mean length of all such fish (μ_{ijkm}) was estimated as

$$\hat{\mu}_{ijkm} = \left(\frac{1}{n_{ijkm}} \right) \sum_r x_{ijkmr} ,$$

with corresponding variance estimator

$$\hat{v}\left(\hat{\mu}_{ijkm}\right) = \left(1 - \frac{n_{ijkm}}{\hat{N}_{ijkm}} \right) \frac{\sum_r \left(x_{ijkmr} - \hat{\mu}_{ijkm} \right)^2}{n_{ijkm}\left(n_{ijkm} - 1 \right)}$$

The mean length of all fish of species i, sex j, and age k (μ_{ijk}) was estimated as a weighted sum of the stratum means, i.e.,

$$\hat{\mu}_{ijk} = \sum_m \left(\frac{\hat{N}_{ijkm}}{\hat{N}_{ijk}} \right) \hat{\mu}_{ijkm}$$

An approximate estimator of the variance of $\hat{\mu}_{ijk}$ was obtained using the delta method (Seber 1982),

$$\hat{v}\left(\hat{\mu}_{ijk}\right) = \sum_{m}\left\{\hat{v}\left(\hat{N}_{ijkm}\right)\left[\frac{\hat{\mu}_{ijkm}}{\sum_{x}\hat{N}_{ijkx}} - \sum_{y}\frac{\hat{N}_{ijky}\,\hat{\mu}_{ijky}}{\left(\sum_{x}\hat{N}_{ijkx}\right)^{2}}\right]^{2} + \left(\frac{\hat{N}_{ijkm}}{\sum_{x}\hat{N}_{ijkx}}\right)^{2}\hat{v}\left(\hat{\mu}_{ijkm}\right)\right\}$$

A chi-square test of independence (Agresti 1990) was used to test the hypothesis of independence of sex and age, by species. Because a fundamental assumption of the test is that the data are derived from a single random sample, the test was modified to accommodate a stratified random sampling design. Using the first order approximation of Rao and Thomas (1989), the usual test statistic was divided by the mean generalized design effect. A significance level of $\alpha = 0.05$ was used.

A two-sample t-test $\alpha = 0.05$ (Systat 8.0) was used to test the hypothesis that male and female fish of age k have equal mean lengths. Data were pooled across all strata and treated as one sample to compare lengths.

Estimates of missed salmon passage

For days when high water prevented accurate counts, estimates were made using percent passage data from previous years with complete data. The passage for the *j*th day with missing data was estimated as:

$$\hat{n}_j = \left[\frac{\sum_{i=1}^{D}\theta_i n_i}{1-\sum_{i=1}^{D}\theta_i p_i}\right] p_j,$$

where

n_i = weir passage on day *i,*

p_i = proportional passage on day *i* based on historical data,

θ_i = an indicator variable defined as 1 if passage was observed on day *i*, 0 otherwise, and

D = number of days in the season.

Results

Weir Operations

The weir was installed by June 16, 2003, and operated through September 14, 2003. During installation, the weir was moved approximately fifteen meters upriver from the previous location to compensate for a loss of bank occurring over winter and spring break-up. Three days (August 16 to 18) of escapement were missed due to high water and poor visibility, estimated passage for these days accounted for less than 1% of the total salmon escapement. No damage occurred to the weir components during the 2003 field season.

Average water depth during 2003 was 82 cm. Water depth during 2003 decreased to a minimum depth of 47 cm by July 23 before rising to a maximum depth of 147 cm on August 28 (Appendix 1). Water temperatures averaged 11°C, and ranged from 16°C on August 10 to 7°C on September 15 (Appendix 1).

Biological Data

Chum Salmon.—A total of 11,625 chum salmon, passed through the weir from June 21 to September 14. Of the 11,625 chum salmon passing the weir, 87 (<1%) were observed with gill net marks (Appendix 2). An estimated 99 chum salmon passed the weir from August 16 to 18, during high water, for a total estimated passage of 11,724 chum salmon (Appendix 2 and 3). Peak weekly passage (N=3,521), representing 30% of the escapement, occurred between July 27 and August 2 (Figure 2). The observed median cumulative passage date occurred on July 27 (Appendix 4).

Four age groups were identified from 1,103 chum salmon sampled from the weir escapement. Males comprised 67% of the chum salmon escapement (Figure 3; Appendix 5). Age 0.3 chum salmon were the most abundant, accounting for 89% of the aged sample (Appendix 5). There was a significant difference in age composition between sexes ($P<0.05$).

Lengths of age 0.3 and 0.4 chum salmon ranged from 360 to 715 mm (Appendix 6). In sampled fish, the mean length of males was greater than that of same-aged females for fish age 0.3 and 0.4 (two-tailed t test: age 0.3, t=11.9, df=967, P=0.000; age 0.4, t= 3.1, df=96, P<0.002). Mean length of males was similar for same-aged females for fish age 0.2 and 0.5, averaging 529 and 581 mm (Appendix 6). Age 0.6 was not present in the 2003 sample.

Chum salmon carcasses were first recorded on July 4, 2003. Median cumulative passage dates for escaping chum salmon and chum salmon carcasses washing onto the weir were separated by 12 days (Figure 4). An estimated 2,772 chum salmon carcasses passed downstream over the weir from July 4 to September 14.

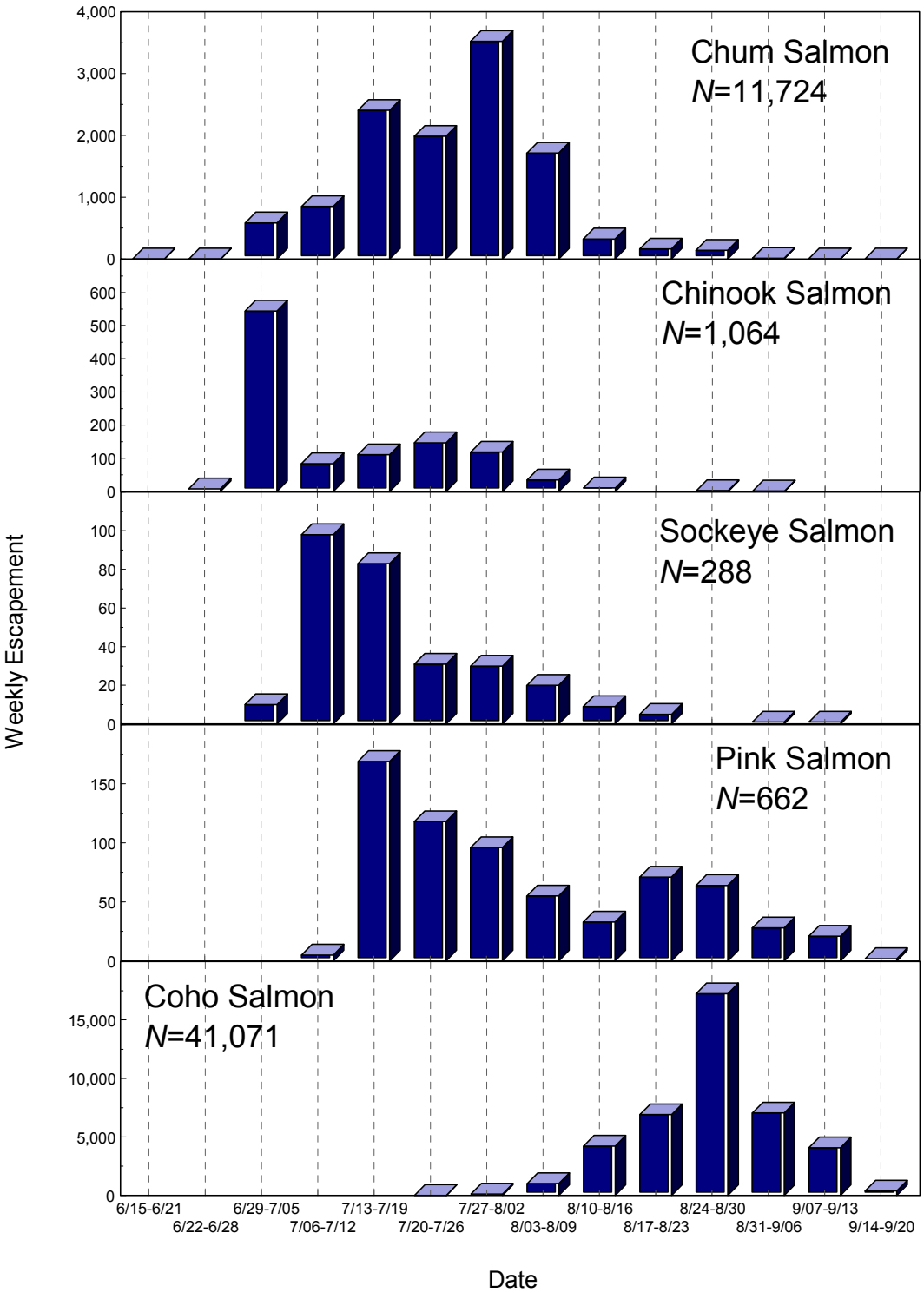

FIGURE 2. —Weekly chum, chinook, sockeye, pink, and coho salmon escapements through the Tuluksak River weir, Alaska, 2003. Escapements include estimates for chum, sockeye, pink, and coho salmon, from August 16 to 18.

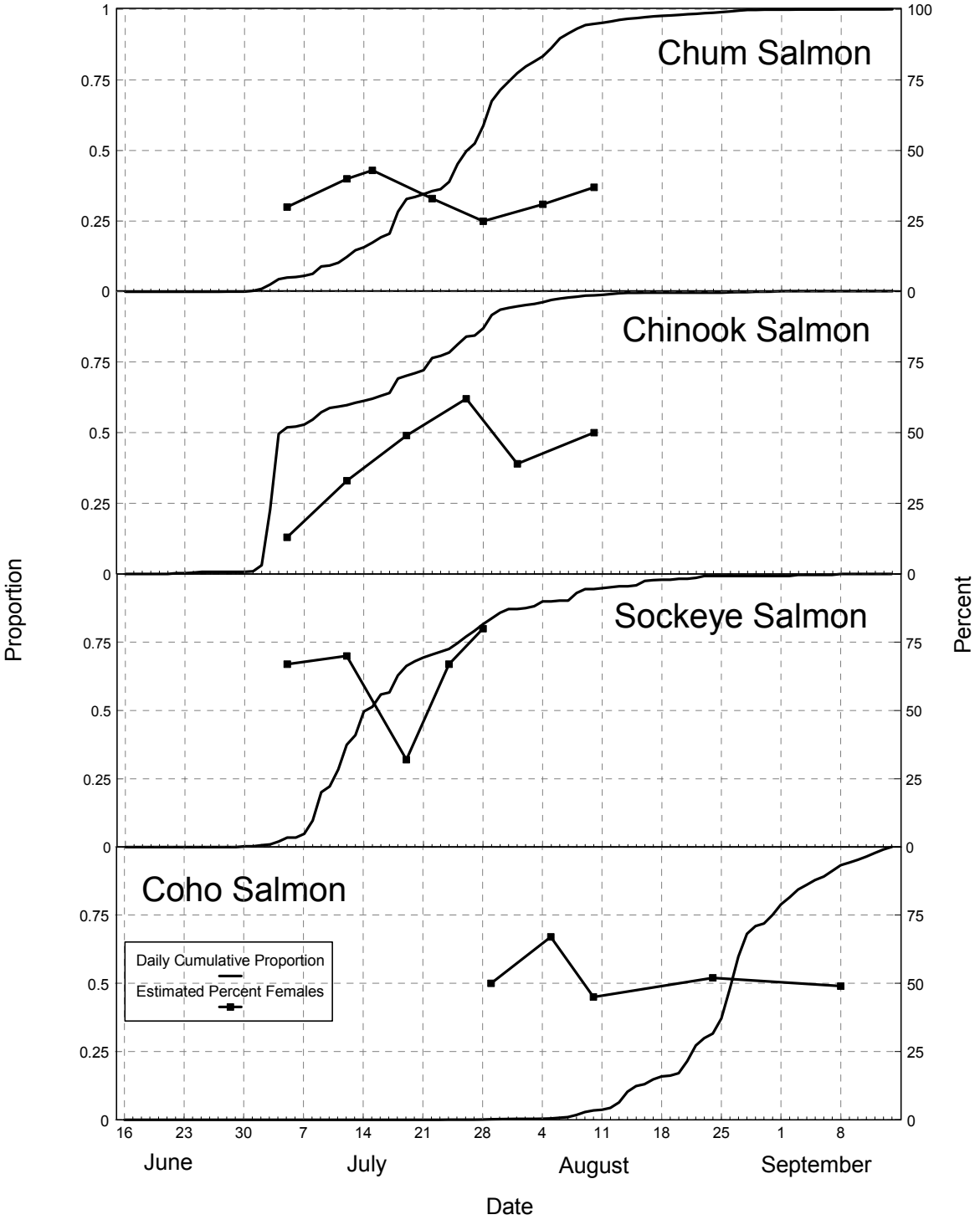

FIGURE 3. —Cumulative proportion and percent females of chum, chinook, sockeye, and coho salmon through the Tuluksak River weir, Alaska, 2003. Cumulative proportions are based on estimates made for chum, sockeye, and coho salmon, from August 16 to 18.

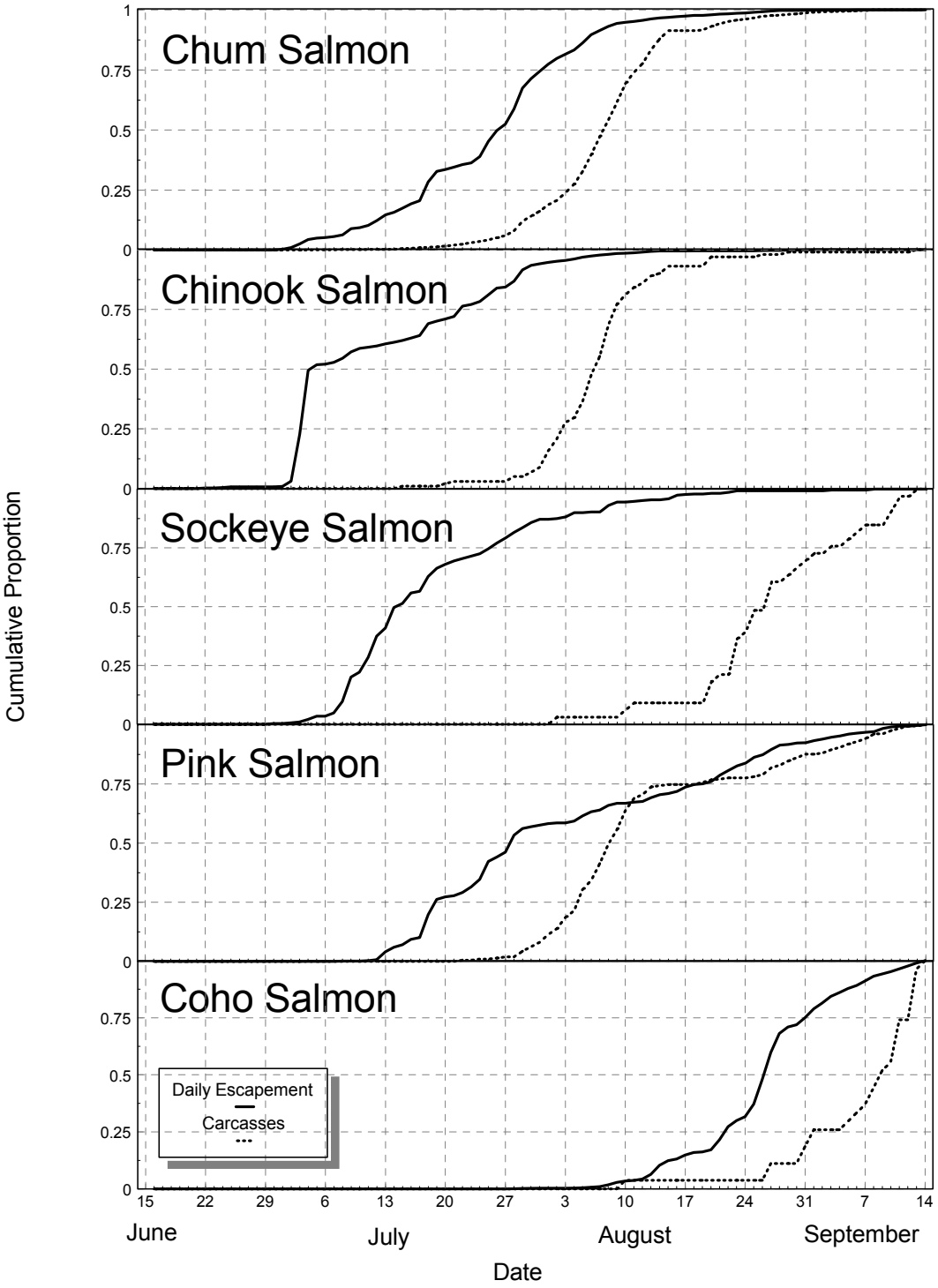

FIGURE 4. —Cumulative proportion of daily salmon passage and carcasses washing onto the upstream side of the Tuluksak River weir, Alaska, 2003. Cumulative proportion includes estimates for chum, sockeye, pink, and coho salmon, from August 16 to 18.

Chinook Salmon.—Chinook salmon (N=1,064) passed through the weir between June 22 and September 1. Of the 1,064 chinook salmon passing the weir, 49 (5%) were observed with gill net marks (Appendix 2). Peak weekly passage occurred between June 29 and July 5 (N=544) (Figure 2). The median cumulative passage date occurred on July 5 (Appendix 4).

Five age groups were identified from 253 chinook salmon sampled between June 16 and September 14, 2003 (Appendix 7). Females composed an estimated 27% of the total chinook salmon escapement (Figure 3; Appendix 7). Age 1.3 and 1.2 dominated the chinook salmon escapement by 39% and 34%, and age 1.4 accounted for 21% (Appendix 7). Age composition differed between sexes ($X^2(\delta.)$=99, df=4, P<0.001). Males were primarily age 1.3 (48%) and 1.2 (47%), and females were predominantly age 1.4 (64%) (Appendix 7).

Lengths at age for 1.3 and 1.4 chinook salmon ranged from 445 to 1,010 mm (Appendix 8). In sampled fish, the mean length of age 1.3 and age 1.4 females was greater than that of same-aged males (two-tailed t test: age 1.3, t=4.2, df=92, P=0.000; age 1.4, t=3.0, df=56, P=0.004) (Appendix 8). Insufficient data was available for comparison of ages 1.2 and 1.5.

Chinook salmon carcasses (N=101) were observed on the weir starting July 15, 2003. This was approximately 23 days after the first chinook salmon was counted through the weir. The median cumulative passage dates for daily escapement and carcasses (August 7) were separated by 33 days (Figure 4).

Sockeye Salmon.—Sockeye salmon (N=282) passed the weir between June 30 and September 8, 2003. An estimated six sockeye salmon passed the weir from August 16 to 18, during high water, for a total estimated passage of 288 sockeye salmon (Appendix 9). Peak weekly passage occurred between July 6 and 12 (N=98) (Figure 2), with a median cumulative passage date of July 15 (Appendix 4).

Three age groups were identified from 52 sockeye salmon sampled between July 2 and 28. Females made up an estimated 63% of the total escapement (Appendix 10). Age 1.3 dominated the sample, accounting for 85%, followed by age 1.2 (8%), and age 1.4 (7%) (Appendix 10). In sampled fish, mean lengths of age 1.3 male sockeye salmon (593 mm) were larger than female sockeye salmon (544 mm) (Appendix 11). Insufficient data was available for comparison of ages 1.2 and 1.4.

Thirty-three sockeye salmon carcasses were counted on the upstream side of the weir during 2003. The first carcass washed onto the weir on August 2, 33 days after the first sockeye salmon was counted through the weir (Figure 4).

Pink Salmon.—Pink salmon (*N*=637) started to pass the weir on July 8 and periodically passed in small numbers until September 14, 2003. An estimated 25 pink salmon passed the weir from August 16 to 18, during high water, for a total estimated passage of 662 pink salmon (Appendix 9). Peak weekly passage was observed between July 13 and 19 (*N*=169) (Figure 2). The median cumulative passage date was July 28 (Appendix 4).

The first pink salmon carcass washed onto the weir on July 22, fourteen days after the first pink salmon was counted through the weir (Figure 4). The median cumulative passage date for pink salmon carcasses was August 9. Two hundred and ten pink salmon carcasses were counted on the weir during operations, which accounted for 33% of the pink salmon counted through the weir. The median cumulative passage dates for daily escapement and carcasses were separated by 12 days (Figure 4).

Coho Salmon.—The first coho salmon passed on July 23 (*N*=2). An estimated escapement of 41,071 coho salmon passed the weir, of which 1,444 were estimated during days of missed counts due to high waters (Appendix 9). Gillnet marks (*N*=966) were observed on 2% of the coho salmon passing the weir (Appendix 2). Peak weekly passage (*N*=17,251) was between August 24 and August 30 (Figure 2). The median cumulative passage date occurred on August 27 (*N*=4,808) (Appendix 4).

Three age classes were identified from 217 sampled coho salmon. The majority (89%) of the coho salmon were age 2.1 (Appendix 12). The remaining sample was comprised of age 3.1 (8.8%) and 1.1 (2.2%) fish. Females composed 52% of the coho salmon escapement (Appendix 12). Age composition did not differ between sexes for age 2.1 and 3.1 ($P>0.05$). Mean lengths were not significantly different ($P>0.05$) for age 2.1 (570 mm) males and (568 mm) females and age 3.1 (588 mm) males and (585 mm) females (Appendix 13). Insufficient age and length composition data were available for age 1.1 (Appendix 13).

Coho salmon carcasses were first recorded on August 10, 2003. Median cumulative passage dates for escaping coho salmon and coho salmon carcasses washing onto the weir were separated by 13 days (Figure 4). By September 14, 2003, when the weir was removed, 27 coho salmon carcasses were passed over the weir.

Resident Species.—Resident species counted through the weir consisted of nine Dolly Varden, 79 whitefish, two northern pike, and 120 Arctic grayling. Although smaller sized resident species were able to pass freely through the pickets, passage through the passage chutes was recorded throughout the entire season (Appendix 2). A total of ten whitefish carcasses and one Arctic grayling carcass was recorded on the weir.

Discussion

Weir Operations

The weir was operated from June 16 through September 14, 2003. Installation was facilitated by low water depths during early June. From mid-June until mid-August low to average water depths continued. After mid-August, higher water levels prevailed, but weir operations were only impacted during one high water event from August 16-18. High water did not interfere with monitoring the peak chum, chinook, sockeye, pink, or coho salmon run timing.

The weir was removed on September 14, 2003 and the substrate rail and cable were left in place to expedite installation in 2004. Sand bags were also placed on the rail and cable to minimize scouring during winter and spring.

Biological Data

Chum Salmon.—The estimated chum salmon escapement in 2003 (*N*=11,724) was within the historic range of 7,675 to 19,321 fish (Figure 5), and slightly above the historical average (*N*=11,669) (Harper 1995a, b, c, Harper 97, Gates et al 2002). The 2003 escapement was 61% of the 2001 chum salmon escapement (*N*=19,321), which is the highest escapement on record.

Other escapement projects located on Kuskokwim River tributaries indicate the 2003 chum salmon escapement was average to above average. The sonar project on the Aniak River, achieved the sustainable escapement goal for the third year in a row (Alaska Department of Fish and Game 2003). Kwethluk River weir chum salmon escapement was 62% above the average escapement observed during its four years of weir operation (Roettiger et al. *in press*).

The median passage date for chum salmon occurred on July 27, seven days later than the historical average of July 29 (Gates and Harper 2003). Similarly, appearance of chum salmon in the Bethel test fishery was late compared to previous years on record (Doug Bue, Alaska Department of Fish and Game, personal communication).

Sex composition was dominated by males, resulting in the lowest proportion of females on record (*N*=33%). This differs from previous years where the sample is dominated by males for the first half of the season, and shifts to females the second half of the season. Percent females for years 1991-1994, and 2001-2002, ranges from 44 to 51%.

The low percent females results from an increase of age 0.3 male chum salmon. The percentage of age 0.3 (89%) chum salmon returning in 2003 represented the highest on record. Males and females of age 0.3 represented 60 and 29% of the total escapement. Although it is common for the chum salmon age composition to be dominated by age 0.3, it is unusual to have males represent twice the number of females present within this age group.

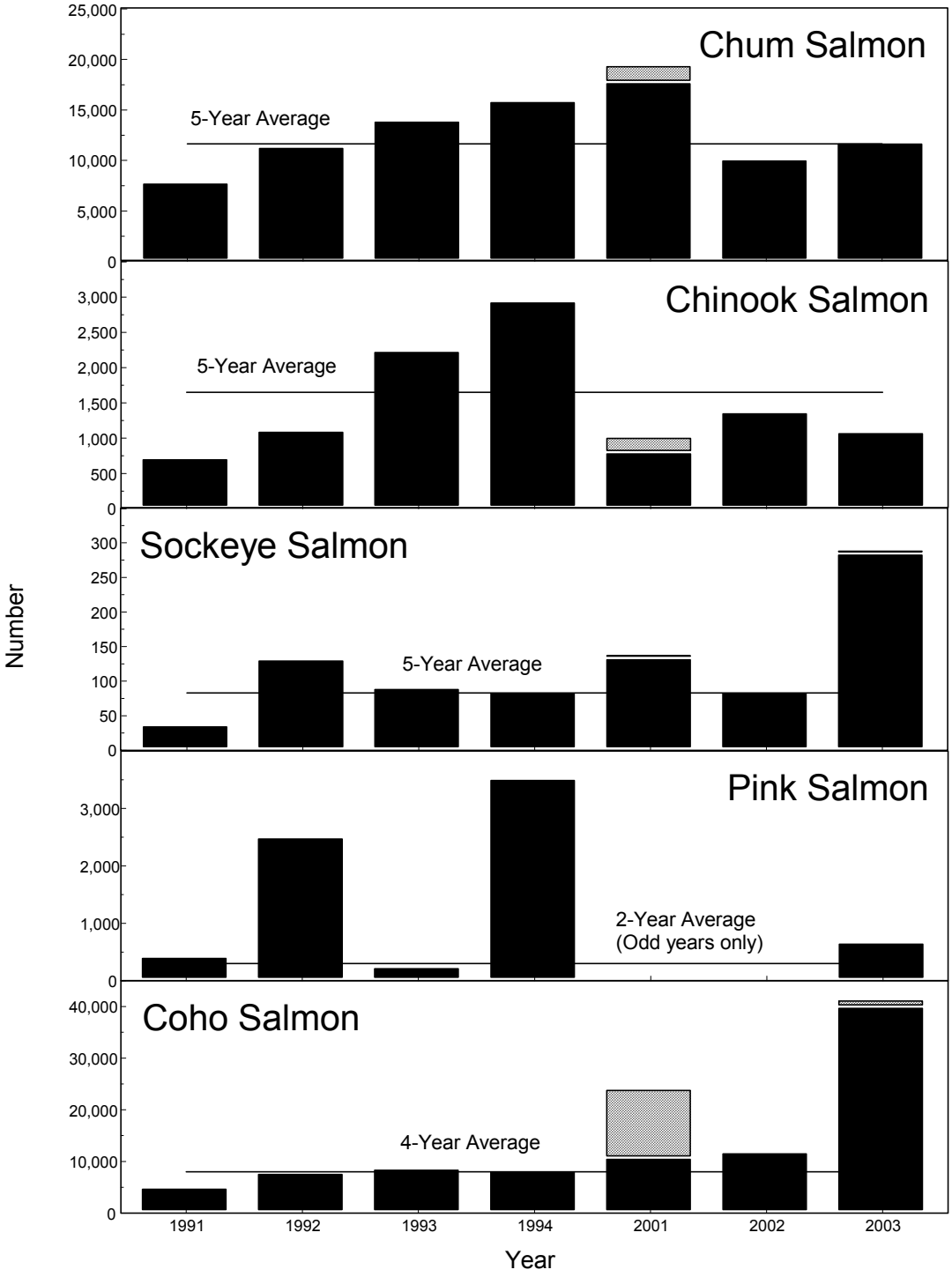

FIGURE 5.—Salmon escapements through the Tuluksak River weir, Alaska, 1991-1994, and 2001-2003. Note shading for estimated counts. Averages were calculated using only years with complete counts. The y-axis uses different scales.

The high percentage of age 0.3 chum salmon results from the 1999 brood year. Although the escapement was not monitored, we assume that a high percentage of four-year old chum salmon returned, resulting in the high return of age 0.3 during 2003, and high return of age 0.2 during 2002 (Gates and Harper 2003). If this trend continues, we can expect to see a large return of age 0.4 chum salmon in 2004.

Gill net marks (*N*=87) were observed on <1% of the chum salmon passing the weir, which is the third lowest percentage of gill net marks observed at Tuluksak weir. Gill net marks were more frequently observed during years when a commercial harvest for chum salmon occurred in late June and early July, as confirmed during commercial fishing periods in 1991 and 1992 (5 and 4%, respectively). No commercial fishery was directed at chum salmon during 2003, resulting in <1% of observed gill net marks at the weir.

Chinook Salmon.—The chinook salmon count during 2003 (*N*=1,064) was complete, making it the third largest escapement on record (Figure 5), and 64% of the historical average (*N*=1,652). Run timing in 2003 was early; the median passage date occurred seven days before the average (Appendix 4) (Gates and Harper 2003). Chinook salmon median passage dates for all six years of weir operation are between July 10 and July 14. Run timing in the Tuluksak River was early and correlates with the timing observed in the Kuskokwim Bethel test fishery, which was reported five days early (Doug Bue, Alaska Department of Fish and Game, personal communication).

In the past, Tuluksak River chinook salmon returns were dominated by age 1.2, 1.3 and 1.4 fish, with age 1.3 the most prevalent, dominated by males, and age 1.4 dominated by females. The 2003 chinook salmon return is similar in that age 1.3 fish are the most dominate age group, mostly represented by males, and females dominate age 1.4.

Percentage of chinook salmon females (27%) during 2003 was the second highest on record, the first was in 1991 (29%). The range of percent females is 14 to 29%, with an average of 21%.

Management actions may have led to the increase in percent females in the escapement. The subsistence fishing schedule maintained windows of fishing. These windows of four days of fishing and three days of closure were designed to allow for an adequate subsistence harvest and for pulses of fish that were not harvested to spawn. Escapement goals were anticipated being made and on July 6 managers opened the subsistence fishing schedule to seven days per week. As a result, many Kuskokwim River tributaries met their escapement goals and subsistence users were able to harvest adequate numbers of fish. No commercial fishing occurred for chinook salmon during 2003.

Even though the Tuluksak River chinook salmon run was below the historical average, other escapement monitoring projects demonstrated that Kuskokwim River chinook salmon returned in greater strength than anticipated. The Kwethluk River weir chinook salmon escapement was the highest escapement on record (Roettiger et al. *in press*).

Kogrukluk River weir exceeded the 10,000 chinook salmon escapement goal with 11,771 chinook salmon (Alaska Department of Fish and Game 2003).

Aerial surveys of Tuluksak River have been conducted by the Department sporadically since 1965. Optimal time for the Tuluksak River chinook salmon aerial survey is late July. This time period coincides with more than 90% of upstream passage through the weir, and less than 10% of the carcasses passing downstream. During 2003, an aerial survey on July 28 estimated 94 chinook salmon. At the time of the 2003 aerial survey, less than 5% of the chinook carcasses had passed down over the weir. This is the first aerial survey that has been conducted by the Department since 1997. An aerial survey goal for Tuluksak River chinook salmon has not been established due a "lack of sufficient historical escapement and stock contribution data" (Alaska Department of Fish and Game 2004).

From 1991-1994, and 2002-2003, the difference between median cumulative passage dates for upstream migrants and downstream carcass passage at the weir ranged from 21 to 33 days. During all years, the median cumulative passage dates for carcasses occurred between August 2 and August 8.

Gill net marks (N=49) were observed on 5% of the chinook salmon passing the weir. Historically gill net marks have ranged from 1 to 10% (Harper 1995 a, b, c; Harper 1997; Gates and Harper 2003). Similar to chum salmon, a higher percentage of gill net marks are typically present during years with commercial openings occurring late June and early July (1991 and 1992; 10%). No commercial fishery was directed at chinook salmon during 2003, resulting in less observed gill net marks at the weir.

Sockeye Salmon.—The total number of sockeye salmon passing the Tuluksak River weir has been consistently small (N<150). The sockeye salmon escapement in 2003 (N=282) was the highest escapement on record (Figure 5). Fifty-one percent had passed the weir by July 15, one day after the earliest median passage date on record. Median passage dates have previously ranged between July 14 and August 2 (1991-1994, 2001 and 2002).

Since only a small population of sockeye salmon return to the Tuluksak River, only a small sample was taken for age and length analysis. The sample was dominated by age 1.3 (85%), most of which were females. This is similar to historical data collected in 1991-1993. Percent females for sockeye salmon were 63%, which is also within the range of historical data from 1991-1994 (49, 43, 83, and 33% respectively).

Currently, sockeye are not actively managed in the lower Kuskokwim River commercial fishing districts from the mouth of the Kuskokwim River up to the village of Tuluksak (Ward et al. 2003). Given the low number of sockeye salmon returning to the Tuluksak River, potential bycatch of sockeye during commercial and subsistence chum salmon fisheries could cause overexploitation.

Pink Salmon.—Kuskokwim River pink salmon have strong even-year runs (Francisco et al. 1992). This was observed between 1991 and 1994 where even years averaged 2,979 and odd years averaged 301 individuals (Figure 5). Commercial catches have averaged 4,028 during even years from 1992 to 2000 in Kuskokwim River Districts 1 and 2 (Ward et al. 2003). The estimated 2003 pink salmon escapement was (*N*=662), considerably higher than the odd year average (*N*=301) escapements (Appendix 9). Pink salmon odd year escapements have ranged from 45 to 392 fish (1991, 1993, and 2001) (Appendix 9). The median passage of July 28 is within the range of odd year median passage dates: July 20 in 1991, August 5 in 1993, and August 4 in 2001. Currently, no pink salmon escapement goals have been established and very little is known about the Kuskokwim River pink salmon stocks.

Coho Salmon.—The 2003 coho salmon escapement was approximately five times the historical average, and, as a result, is the highest escapement ever recorded for the Tuluksak River (Figure 5). The second highest coho salmon escapement returning to the Tuluksak River was in 2001 with an estimated 23,768 fish (Appendix 9). Larger returns occurred in other Kuskokwim tributaries during 2003. The Kogrukluk River escapement exceeded the sustainable escapement goal, and similarly Kwethluk, George, and Takotna rivers all exhibited record coho salmon escapements (Alaska Department of Fish and Game 2003; Roettiger et al. *in press*).

Run timing in 2003 was similar to run timing observed during all years of weir operations, 1991-1994 and 2001-2002, with the exception of 1991. The median passage date for coho salmon was August 27, two days before the August 29 average (Appendix 4).

The estimated percent of female coho salmon (52%) in 2003 was within the range of previous year's data, (43-58%). Because of the intra annual stability of the sex ratio and age composition, the sample size was reduced from 210 fish per strata to a total of 210 fish for the entire season, with samples collected from the beginning middle and end of the run.

Similar to past years, age 2.1 was the dominate age group for 2003, representing an estimated 89% of the escapement. Ages 1.1, 2.1, and 3.1 were also present in the escapement. Age 2.1 has been the primary age group in all years of operations. Females age 2.1 made up between 32% and 49% of the total escapement each year.

The percentage of gill net marks was lower in the 2003 weir escapement (2%) compared to previous years. In comparison, gill net marks were observed on 9, 5, and 3% of the coho salmon from 1991 to 1993 and 2002. Coho escapements for 1994 and 2001 were estimated; therefore the gill net marks were not an accurate count for these years. The number of gill net marks has decreased with the decrease of commercial fishing time and harvest of coho salmon. During 2003 record returns of coho salmon to the Kuskokwim River and a limited commercial fishery contributed to the low number of gill net marks observed at the weir.

Coho salmon carcasses were first recorded on August 10, 2003. By September 14, 2003, 27 coho salmon carcasses were passed over the weir. This is the highest carcass count of coho salmon observed on the Tuluksak River. Carcass counts observed from 1991 to 1994, 2001 and 2002 ranged from 4 to 13 coho salmon. As observed in previous years, coho salmon carcasses were still passing downstream after the weir was removed.

Recommendations

The Tuluksak River weir is an important tool for monitoring refuge-originating salmon stocks. This weir continues to be the longest running data set in the lower Kuskokwim River, with seven years of operation. Long data sets such as those from the Tuluksak are particularly important for studying the relationship between habitat and establishment of escapement goals. Therefore we recommend the continuation of weir operations from mid-June to early-September to obtain comprehensive escapement data for all salmon species. As long as the weir is in place and operational, aerial surveys are not necessary for monitoring but can be used to determine the relationship between weir escapements and aerial surveys. Aerial survey/weir relationships can be used to monitor other rivers without escapement projects. Aerial surveys and aerial photography can also play an important role in establishing habitat based escapement goals and determine if the habitat is fully utilized.

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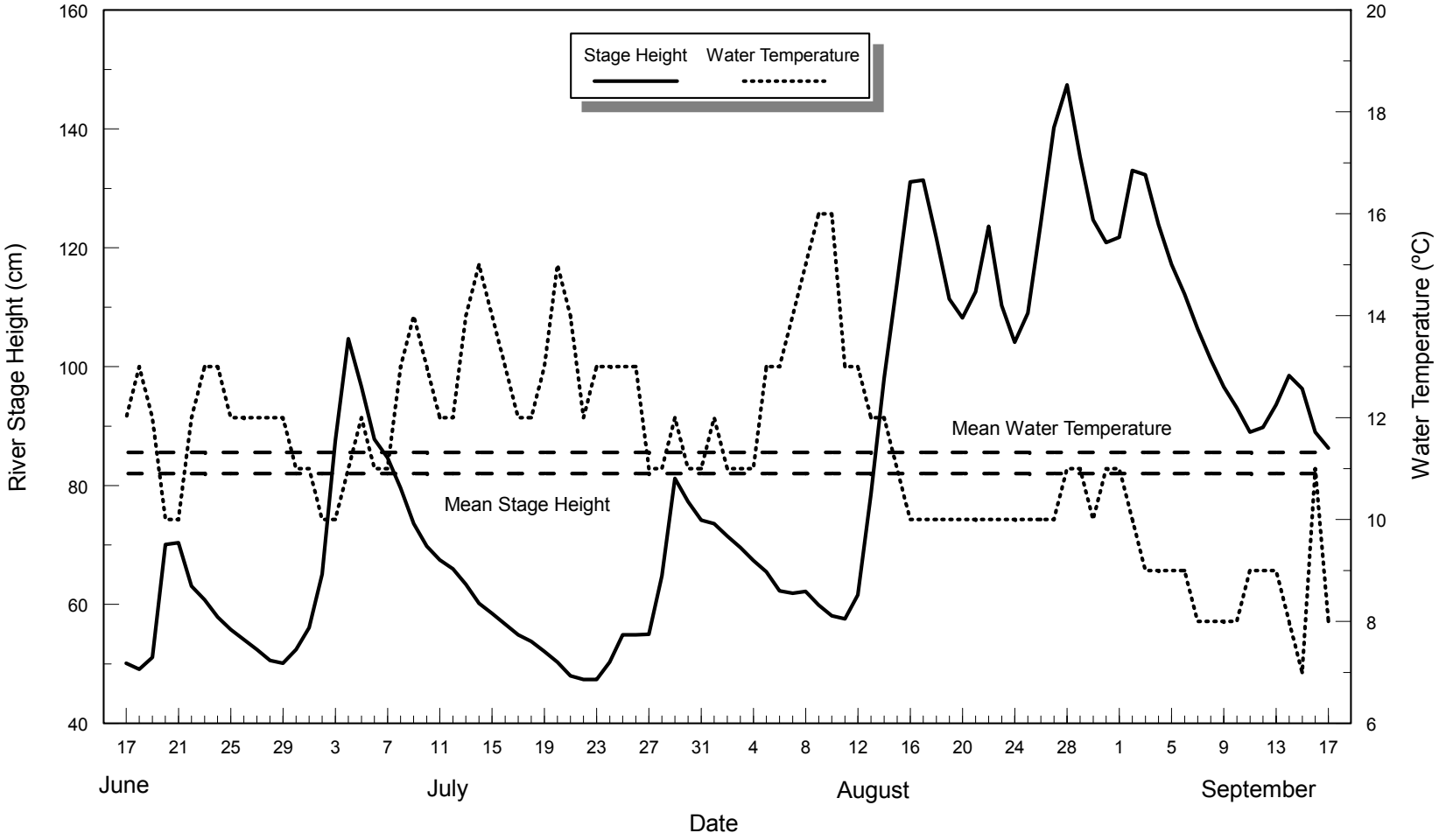

APPENDIX 1.—River stage heights and water temperatures at the Tuluksak River weir, 2003.

APPENDIX 2.—Daily escapement and counting effort at the Tuluksak River weir, Alaska, 2003.

Date	Counting Effort (hours)	Chum Salmon	Chinook Salmon	Sockeye Salmon	Pink Salmon	Coho Salmon	Gill Net Marks: Chum Salmon	Gill Net Marks: Chinook Salmon	Gill Net Marks: Sockeye Salmon	Gill Net Marks: Pink Salmon	Gill Net Marks: Coho Salmon	Dolly Varden	Whitefish	Northern Pike	Arctic Grayling
							Stratum 1								
06/15															
06/16	11.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06/17	31.00	0	0	0	0	0	0	0	0	0	0	0	0	0	2
06/18	31.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06/19	30.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06/20	31.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06/21	30.00	2	0	0	0	0	0	0	0	0	0	0	1	0	1
Observed:	165.50	2	0	0	0	0	0	0	0	0	0	0	1	0	3
							Stratum 2								
06/22	29.25	0	3	0	0	0	0	0	0	0	0	0	0	0	2
06/23	29.50	0	0	0	0	0	0	0	0	0	0	0	0	0	2
06/24	29.50	2	2	0	0	0	0	0	0	0	0	0	0	0	3
06/25	30.00	0	3	0	0	0	0	0	0	0	0	0	0	0	0
06/26	29.25	0	0	0	0	0	0	0	0	0	0	0	0	0	1
06/27	27.00	0	0	0	0	0	0	0	0	0	0	0	0	0	1
06/28	32.00	1	0	0	0	0	0	0	0	0	0	0	0	0	2
Observed:	206.50	3	8	0	0	0	0	0	0	0	0	0	0	0	11
							Stratum 3								
06/29	32.00	4	0	0	0	0	0	0	0	0	0	0	0	0	0
06/30	32.00	0	0	1	0	0	0	0	0	0	0	0	0	0	1
07/01	31.50	35	2	0	0	0	0	0	0	0	0	0	0	0	5
07/02	29.00	80	23	1	0	0	0	0	0	0	0	0	0	0	4
07/03	18.75	181	209	1	0	0	1	1	0	0	0	0	0	0	0
07/04	11.75	217	286	3	0	0	5	10	0	0	0	0	0	0	2
07/05	14.00	70	24	4	0	0	6	2	0	0	0	0	0	0	0
Observed:	169.00	587	544	10	0	0	12	13	0	0	0	0	0	0	12

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APPENDIX 2.—(Page 2 of 5)

Date	Counting Effort (hours)	Chum Salmon	Chinook Salmon	Sockeye Salmon	Pink Salmon	Coho Salmon	Gill Net Marks: Chum Salmon	Gill Net Marks: Chinook Salmon	Gill Net Marks: Sockeye Salmon	Gill Net Marks: Pink Salmon	Gill Net Marks: Coho Salmon	Dolly Varden	Whitefish	Northern Pike	Arctic Grayling
Stratum 4															
07/06	15.25	23	3	0	0	0	1	0	0	0	0	0	0	0	0
07/07	24.00	48	8	4	0	0	0	1	0	0	0	0	0	0	1
07/08	15.25	83	18	14	1	0	0	4	0	0	0	0	0	0	2
07/09	11.25	306	28	30	0	0	7	5	0	0	0	0	0	0	0
07/10	15.50	43	16	6	0	0	0	1	0	0	0	0	0	0	0
07/11	15.00	113	5	18	1	0	0	1	0	0	0	0	0	0	0
07/12	14.25	236	6	26	3	0	0	0	1	0	0	0	0	0	1
Observed:	110.50	852	84	98	5	0	8	12	1	0	0	0	0	0	4
Stratum 5															
07/13	11.50	281	9	10	22	0	8	0	1	0	0	0	0	0	0
07/14	12.50	123	7	25	13	0	2	1	2	0	0	0	0	0	4
07/15	18.50	197	8	5	7	0	0	0	0	0	0	0	0	0	0
07/16	14.75	216	11	13	15	0	0	1	0	0	0	0	0	0	1
07/17	14.00	150	11	2	5	0	2	1	0	0	0	0	1	0	0
07/18	15.00	916	54	18	64	0	21	6	0	0	0	0	0	0	0
07/19	16.00	523	11	10	43	0	4	0	1	0	0	0	0	0	1
Observed:	102.25	2,406	111	83	169	0	37	9	4	0	0	0	1	0	6
Stratum 6															
07/20	13.25	89	9	5	7	0	2	0	0	0	0	0	0	0	0
07/21	11.25	113	11	4	3	0	1	0	1	0	0	0	0	0	0
07/22	13.75	130	46	3	9	0	2	3	1	0	0	0	0	0	1
07/23	15.00	78	8	3	16	2	0	1	0	0	0	0	0	0	0
07/24	17.00	305	13	3	21	4	0	2	2	0	0	0	0	0	0
07/25	15.00	740	30	6	50	4	0	5	0	0	0	0	0	0	1
07/26	14.75	532	30	7	12	7	0	0	0	0	0	0	0	0	1
Observed:	100.00	1,987	147	31	118	17	5	11	4	0	0	0	0	0	3

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APPENDIX 2.—(Page 3 of 5)

Date	Counting Effort (hours)	Chum Salmon	Chinook Salmon	Sockeye Salmon	Pink Salmon	Coho Salmon	Gill Net Marks: Chum Salmon	Gill Net Marks: Chinook Salmon	Gill Net Marks: Sockeye Salmon	Gill Net Marks: Pink Salmon	Gill Net Marks: Coho Salmon	Dolly Varden	Whitefish	Northern Pike	Arctic Grayling
Stratum 7															
07/27	6.25	318	4	6	14	0	2	0	0	0	0	0	0	0	0
07/28	13.50	738	27	7	48	14	1	0	0	0	0	0	0	0	4
07/29	10.75	1,020	50	6	18	45	0	4	0	0	0	0	0	0	0
07/30	15.25	459	20	6	5	19	0	0	0	0	0	0	0	0	2
07/31	15.50	358	7	4	5	11	1	0	0	0	0	0	0	0	0
08/01	15.50	345	6	0	4	15	0	0	0	0	0	1	0	0	0
08/02	15.50	283	5	1	2	15	1	0	0	0	0	0	0	0	3
Observed:	92.25	3,521	119	30	96	119	5	4	0	0	0	1	0	0	9
Stratum 8															
08/03	9.50	203	4	2	0	3	1	0	0	0	0	1	0	0	0
08/04	12.75	214	6	5	5	13	2	0	0	0	0	2	0	0	1
08/05	14.50	344	9	0	15	38	0	0	0	0	0	0	0	1	0
08/06	15.50	403	5	1	11	102	0	0	0	0	0	0	0	0	0
08/07	14.75	202	4	0	5	101	0	0	0	0	0	1	0	0	1
08/08	14.00	199	3	8	13	335	0	0	0	0	2	0	0	0	0
08/09	15.25	150	4	4	6	435	0	0	0	0	2	0	0	0	1
Observed:	96.25	1,715	35	20	55	1,027	3	0	0	0	4	4	0	1	3
Stratum 9															
08/10	8.00	50	1	0	0	241	2	0	0	0	0	0	0	0	0
08/11	14.00	41	2	1	3	101	0	0	0	0	2	0	0	0	0
08/12	27.00	55	3	1	2	268	0	0	0	0	0	3	0	0	0
08/13	25.00	67	3	1	11	839	0	0	0	0	1	0	0	0	0
08/14	21.00	47	2	0	8	1,621	0	0	0	0	8	0	0	0	0
08/15	17.00	27	0	1	3	854	0	0	0	0	5	0	1	0	0
08/16 [a]	0.00	39	0	5	6	289	0	0	0	0	0	0	0	0	0
Observed:	112.00	326	11	9	33	4,213	2	0	0	0	16	3	1	0	0
Estimated:		39	0	5	6	289	0	0	0	0	0	0	0	0	0

[a] No counts due to high water.

Estimates were calculated using historical percent passage data from previous years with complete data.

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APPENDIX 2.—(Page 4 of 5)

Date	Counting Effort (hours)	Chum Salmon	Chinook Salmon	Sockeye Salmon	Pink Salmon	Coho Salmon	Gill Net Marks: Chum Salmon	Gill Net Marks: Chinook Salmon	Gill Net Marks: Sockeye Salmon	Gill Net Marks: Pink Salmon	Gill Net Marks: Coho Salmon	Dolly Varden	Whitefish	Northern Pike	Arctic Grayling
Stratum 10															
08/17 [a]	0.00	33	0	1	12	716	0	0	0	0	0	0	0	0	0
08/18 [a]	0.00	27	0	0	7	439	0	0	0	0	0	0	0	0	0
08/19	5.75	10	0	0	2	140	0	0	0	0	0	0	0	0	0
08/20	12.25	25	0	1	6	366	0	0	0	0	1	0	4	0	0
08/21	14.00	25	0	0	18	1,799	1	0	0	0	9	0	0	0	0
08/22	10.00	20	0	1	13	2,341	0	0	0	0	39	0	6	0	3
08/23	8.25	25	0	2	13	1,116	0	0	0	0	13	0	4	0	8
Observed:	50.25	165	0	5	71	6,917	1	0	0	0	62	0	14	0	11
Estimated:		60	0	1	19	1,155	0	0	0	0	0	0	0	0	0
Stratum 11															
08/24	13.00	20	0	0	8	690	1	0	0	0	16	0	2	0	4
08/25	11.50	27	0	0	16	2,271	2	0	0	0	51	0	3	0	9
08/26	14.25	30	1	0	7	4,498	2	0	0	0	118	1	12	0	8
08/27	13.25	31	1	0	15	4,808	2	0	0	1	120	0	2	0	2
08/28	12.50	26	0	0	12	3,416	3	0	0	0	122	0	0	0	2
08/29	8.75	3	1	0	2	1,167	0	0	0	0	21	0	0	0	0
08/30	5.50	5	0	0	4	401	0	0	0	0	10	0	0	0	0
Observed:	78.75	142	3	0	64	17,251	10	0	0	1	458	1	19	0	25
Stratum 12															
08/31	11.50	3	1	0	1	1,279	2	0	0	0	47	0	3	0	4
09/01	12.50	3	1	0	6	1,602	1	0	0	0	43	0	2	0	4
09/02	12.50	2	0	0	4	1,057	0	0	0	0	32	0	2	0	2
09/03	12.75	2	0	1	5	1,181	0	0	0	0	38	0	1	0	3
09/04	12.75	0	0	0	4	693	0	0	0	0	30	0	3	0	5
09/05	13.25	2	0	0	5	727	1	0	0	0	37	0	5	0	5
09/06	12.75	1	0	0	3	510	0	0	0	0	17	0	2	0	0
Observed:	88.00	13	2	1	28	7,049	4	0	0	0	244	0	18	0	23

[a] No counts due to high water.

Estimates were calculated using historical percent passage data from previous years with complete data.

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APPENDIX 2.—(Page 5 of 5)

Date	Counting Effort (hours)	Chum Salmon	Chinook Salmon	Sockeye Salmon	Pink Salmon	Coho Salmon	Gill Net Marks: Chum Salmon	Gill Net Marks: Chinook Salmon	Gill Net Marks: Sockeye Salmon	Gill Net Marks: Pink Salmon	Gill Net Marks: Coho Salmon	Dolly Varden	Whitefish	Northern Pike	Arctic Grayling
						Stratum 13									
09/07	13.00	0	0	0	2	850	0	0	0	0	35	0	4	0	3
09/08	4.75	1	0	1	2	862	0	0	0	0	48	0	4	0	3
09/09	12.25	0	0	0	9	395	0	0	0	0	24	0	3	1	0
09/10	12.75	0	0	0	4	424	0	0	0	0	22	0	3	0	2
09/11	12.25	2	0	0	2	477	0	0	0	0	18	0	10	0	1
09/12	12.50	0	0	0	0	542	0	0	0	0	11	0	1	0	0
09/13	12.25	1	0	0	2	527	0	0	0	0	10	0	0	0	0
Observed:	79.75	4	0	1	21	4,077	0	0	0	0	168	0	25	1	9
						Stratum 14									
09/14	12.50	1	0	0	2	401	0	0	0	0	14	0	0	0	1
09/15															
09/16															
09/17															
09/18															
09/19															
09/20															
Observed:	12.50	1	0	0	2	401	0	0	0	0	14	0	0	0	1
Total Observed:	1463.50	11,625	1,064	282	637	39,627	87	49	9	1	966	9	79	2	120
Total Estimated:		99	0	6	25	1,444	0	0	0	0	0	0	0	0	0
Combined Total:		11,724	1,064	288	662	41,071	87	49	9	1	966	9	79	2	120

[a] No counts due to high water.

Estimates were calculated using historical percent passage data from previous years with complete data.

APPENDIX 3.—Daily chum and chinook salmon counts at the Tuluksak River weir, Alaska, 1991-1994, and 2001-2003.

	Chum Salmon							(% passage) (91-94 & 02)[a]	Chinook Salmon							(% passage) (91-94 & 02)[a]
Date	1991	1992	1993	1994	2001	2002	2003		1991	1992	1993	1994	2001	2002	2003	
6/10						0								0		
6/11						0								0		
6/12						0								0		
6/13						0								0		
6/14						1			0					0		
6/15						1			0			0		0		
6/16						0	0		0			0		0	0	
6/17						0	0		0		0	0		0	0	
6/18			1			0	0		0		0	0		0	0	
6/19	1		1			0	0		0		0	0		0	0	
6/20	0		0			0	0		0		0	0		0	0	
6/21	0		10			0	2		0		0	0		1	0	
6/22	0		2			15	0		0		1	0		0	3	
6/23	1		1			0	0		1		0	0		0	0	
6/24	0	1	7			10	2		3	0	0	0		1	2	
6/25	0	39	18			8	0		0	0	1	0		1	3	
6/26	3	80	17			30	0		3	1	0	0		0	0	
6/27	6	75	22			22	0		3	0	2	0		4	0	
6/28	2	71	42			191	1		4	2	1	0		9	0	
6/29	11	93	26	8	59	173	4		1	4	0	0	1	133	0	
6/30	20	170	37	4	100	54	0		6	10	14	5	6	26	0	
7/1	23	242	101	8	157	230	35		8	15	40	4	11	17	2	
7/2	50	96	146	34	134	102	80		6	12	35	5	9	6	23	
7/3	64	155	119	35	160	51	181		6	22	102	3	19	7	209	
7/4	113	140	154	96	215	80	217		28	85	84	26	41	11	286	
7/5	97	150	149	121	215	198	70		13	40	120	69	33	59	24	
7/6	59	107	205	70	177	220	23		24	13	187	29	35	247	3	
7/7	115	158	313	321	349	295	48		15	28	157	391	63	57	8	
7/8	279	229	312	294	196	30	83		23	55	37	109	19	48	18	
7/9	161	228	242	288	99	79	306		37	71	93	184	3	22	28	
7/10	326	280	255	211	150	75	43		254	117	171	70	12	2	16	
7/11	296	241	379	495	367	545	113		8	53	100	144	66	51	5	
7/12	276	202	215	401	574	230	236		38	25	215	254	63	29	6	
7/13	169	254	341	553	648	451	281		12	32	107	176	90	194	9	
7/14	120	307	467	476	985	284	123		4	47	80	160	218	27	7	
7/15	169	418	413	754	771	196	197		5	38	43	142	26	12	8	
7/16	210	387	402	615	949	675	216		11	32	58	83	31	24	11	

Estimated escapement during 1994 & 2001

-continued-

APPENDIX 3.—(Page 2 of 3)

Date	Chum Salmon 1991	1992	1993	1994	2001	2002	2003	(% passage) (91-94 & 02)[a]		Chinook Salmon 1991	1992	1993	1994	2001	2002	2003	(% passage) (91-94 & 02)[a]
7/17	158	174	816	625	228	686	150			32	8	63	85	9	26	11	
7/18	390	510	1,010	587	441	764	916			43	24	60	150	13	74	54	
7/19	298	318	745	942	737	620	523			27	27	64	191	23	54	11	
7/20	234	265	534	808	923	76	89			15	12	61	165	24	13	9	
7/21	219	260	563	690	582	191	113			14	16	47	96	13	21	11	
7/22	232	483	377	1,006	656	210	130			10	40	54	77	19	16	46	
7/23	154	559	250	952	1,063	370	78			3	46	18	18	18	19	8	
7/24	124	664	243	589	368	87	305			12	67	23	32	4	3	13	
7/25	155	430	255	747	889	249	740			5	44	10	68	16	30	30	
7/26	107	230	324	525	857	254	532			1	12	15	23	9	25	30	
7/27	94	263	451	609	876	252	318			4	9	24	36	20	28	4	
7/28	142	330	387	487	620	264	738			2	8	24	36	2	5	27	
7/29	260	313	301	374	183	161	1,020			4	7	14	9	3	4	50	
7/30	250	200	322	194	229	228	459			1	9	21	12	2	6	20	
7/31	158	238	387	191	724	135	358			0	5	10	2	12	13	7	
8/1	131	196	334	173	445	172	345			0	6	10	8	5	2	6	
8/2	139	211	248	188	284	88	283			2	3	2	5	7	3	5	
8/3	190	143	184	170	267	88	203			1	4	1	5	6	4	4	
8/4	168	119	234	175	308	142	214			0	2	7	4	5	2	6	
8/5	159	137	213	202	265	58	344			0	7	4	6	5	0	9	
8/6	208	135	194	130	390	51	403			1	4	9	8	3	1	5	
8/7	153	70	193	89	223	58	202			0	3	13	2	3	2	4	
8/8	92	117	148	54	412	39	199			0	2	3	5	2	0	3	
8/9	107	103	83	53	179	39	150			0	1	5	2	3	2	4	
8/10	118	80	63	63	114	41	50			0	0	1	1	1	1	1	
8/11	99	97	54	37	60	42	41			0	2	5	2	0	1	2	
8/12	73	82	48	7	86	47	55			1	0	1	0	5	1	3	
8/13	78	32	53	23	182	35	67			3	0	0	2	9	0	3	
8/14	61	33	50	22	82	19	47			1	1	0	1	0	0	2	
8/15	38	28	31	33	83	39	27			1	1	0	2	2	0	0	
8/16	53	16	23	22	24	50	39	0		0	0	0	1	3	0	0	0.00007
8/17	55	30	15	19	11	18	33	0		0	0	0	0	2	0	0	0.00000
8/18	31	22	30	18	8	23	27	0		0	1	1	1	0	0	0	0.00034
8/19	29	20	27	7	17	21	10			0	0	0	0	1	2	0	
8/20	27	22	55	9	19	17	25			0	0	0	1	0	0	0	
8/21	16	25	26	2	31	14	25			1	2	0	1	1	0	0	

Estimated escapement during 1994 & 2001

Estimated escapement during 2003

[a] Proportions for day missed.

Estimates were made using historical percent passage data from previous years with complete data.

-continued-

APPENDIX 3.—(Page 3 of 3)

	Chum Salmon							(% passage) (91-94 & 02)[a]	Chinook Salmon							(% passage) (91-94 & 02)[a]
Date	1991	1992	1993	1994	2001	2002	2003		1991	1992	1993	1994	2001	2002	2003	
8/22	9	13	9	3	15	16	20		0	1	0	0	0	0	0	
8/23	17	18	16	6	26	9	25		0	0	0	0	0	0	0	
8/24	11	4	9	5	13	3	20		0	0	0	0	0	0	0	
8/25	13	9	22	1	20	4	27		0	1	0	0	0	0	0	
8/26	7	8	24	18	22	2	30		0	0	0	0	0	0	1	
8/27	6	15	19	18	14	3	31		0	0	0	0	0	0	1	
8/28	2	9	8	9	4	0	26		0	1	0	1	0	0	0	
8/29	7	6	6	10	3	1	3		0	0	0	0	0	0	1	
8/30	11	1	3	9	1	8	5		0	2	0	2	0	0	0	
8/31	6	1	2	5	2	1	3		0	0	0	0	0	0	1	
9/1	0	2	6	3	1	5	3		0	2	0	2	0	0	1	
9/2	6	8	2	3	9	3	2		0	1	0	0	0	0	0	
9/3	1	2	2	1	3	0	2		0	0	0	0	0	0	0	
9/4	4	0	1	8	5	4	0		0	0	0	1	0	0	0	
9/5	2	3	2	3	4	4	2		0	0	0	0	0	0	0	
9/6	1	2	0	2	2	0	1		0	0	0	0	0	0	0	
9/7	0	1	2	4	2	0	0		0	0	0	0	0	0	0	
9/8	0	1	1	5	2	0	1		0	0	0	0	0	0	0	
9/9	0	2	1	1	2	1	0		0	0	0	0	0	0	0	
9/10	0	0	1	0	0	0	0		0	0	0	0	0	0	0	
9/11	0			3			2		0			1			0	
9/12	0						0		0						0	
9/13	1						1		0						0	
9/14	0						1		0						0	
9/15	0								0							
9/16	0								0							
9/17	0								0							
9/18	0								0							
								% Missed								% Missed
Total	7,675	11,183	13,804	15,724	19,321	9,958	11,724	0.0084	697	1,083	2,218	2,917	998	1,346	1,064	0.00041

Estimated escapement during 1994 & 2001

[a] Proportions for day missed.

Estimates were made using historical percent passage data from previous years with complete data.

APPENDIX 4.—Daily, cumulative, and cumulative proportion of chum, chinook, sockeye, pink, and coho salmon passing through the Tuluksak River weir, Alaska, 2003.

	Chum Salmon			Chinook Salmon			Sockeye Salmon			Pink Salmon			Coho Salmon		
	Daily	Cumulative		Daily	Cumulative		Daily	Cumulative		Daily	Cumulative		Daily	Cumulative	
	Count	Count	Proportion	Count	Count	Proportion	Count	Count	Proportion	Count	Count	Proportion	Count	Count	Proportion
6/15															
6/16	0	0	0.0000	0	0	0.0000	0	0	0.0000	0	0	0.0000	0	0	0.0000
6/17	0	0	0.0000	0	0	0.0000	0	0	0.0000	0	0	0.0000	0	0	0.0000
6/18	0	0	0.0000	0	0	0.0000	0	0	0.0000	0	0	0.0000	0	0	0.0000
6/19	0	0	0.0000	0	0	0.0000	0	0	0.0000	0	0	0.0000	0	0	0.0000
6/20	0	0	0.0000	0	0	0.0000	0	0	0.0000	0	0	0.0000	0	0	0.0000
6/21	2	2	0.0002	0	0	0.0000	0	0	0.0000	0	0	0.0000	0	0	0.0000
6/22	0	2	0.0002	3	3	0.0028	0	0	0.0000	0	0	0.0000	0	0	0.0000
6/23	0	2	0.0002	0	3	0.0028	0	0	0.0000	0	0	0.0000	0	0	0.0000
6/24	2	4	0.0003	2	5	0.0047	0	0	0.0000	0	0	0.0000	0	0	0.0000
6/25	0	4	0.0003	3	8	0.0075	0	0	0.0000	0	0	0.0000	0	0	0.0000
6/26	0	4	0.0003	0	8	0.0075	0	0	0.0000	0	0	0.0000	0	0	0.0000
6/27	0	4	0.0003	0	8	0.0075	0	0	0.0000	0	0	0.0000	0	0	0.0000
6/28	1	5	0.0004	0	8	0.0075	0	0	0.0000	0	0	0.0000	0	0	0.0000
6/29	4	9	0.0008	0	8	0.0075	0	0	0.0000	0	0	0.0000	0	0	0.0000
6/30	0	9	0.0008	0	8	0.0075	1	1	0.0035	0	0	0.0000	0	0	0.0000
7/1	35	44	0.0038	2	10	0.0094	0	1	0.0035	0	0	0.0000	0	0	0.0000
7/2	80	124	0.0106	23	33	0.0310	1	2	0.0069	0	0	0.0000	0	0	0.0000
7/3	181	305	0.0260	209	242	0.2273	1	3	0.0104	0	0	0.0000	0	0	0.0000
7/4	217	522	0.0445	286	528	0.4960	3	6	0.0208	0	0	0.0000	0	0	0.0000
7/5	70	592	0.0505	24	552	0.5186	4	10	0.0347	0	0	0.0000	0	0	0.0000
7/6	23	615	0.0525	3	555	0.5214	0	10	0.0347	0	0	0.0000	0	0	0.0000
7/7	48	663	0.0566	8	563	0.5289	4	14	0.0486	0	0	0.0000	0	0	0.0000
7/8	83	746	0.0636	18	581	0.5458	14	28	0.0972	1	1	0.0015	0	0	0.0000
7/9	306	1,052	0.0897	28	609	0.5721	30	58	0.2014	0	1	0.0015	0	0	0.0000
7/10	43	1,095	0.0934	16	625	0.5872	6	64	0.2223	0	1	0.0015	0	0	0.0000
7/11	113	1,208	0.1030	5	630	0.5919	18	82	0.2848	1	2	0.0030	0	0	0.0000
7/12	236	1,444	0.1232	6	636	0.5975	26	108	0.3751	3	5	0.0075	0	0	0.0000
7/13	281	1,725	0.1471	9	645	0.6060	10	118	0.4098	22	27	0.0407	0	0	0.0000
7/14	123	1,848	0.1576	7	652	0.6125	25	143	0.4966	13	40	0.0604	0	0	0.0000
7/15	197	2,045	0.1744	8	660	0.6200	5	148	0.5140	7	47	0.0709	0	0	0.0000
7/16	216	2,261	0.1929	11	671	0.6304	13	161	0.5591	15	62	0.0936	0	0	0.0000
7/17	150	2,411	0.2057	11	682	0.6407	2	163	0.5661	5	67	0.1011	0	0	0.0000
7/18	916	3,327	0.2838	54	736	0.6914	18	181	0.6286	64	131	0.1977	0	0	0.0000

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APPENDIX 4.—(Page 2 of 3)

	Chum Salmon			Chinook Salmon			Sockeye Salmon			Pink Salmon			Coho Salmon		
	Daily	Cumulative		Daily	Cumulative		Daily	Cumulative		Daily	Cumulative		Daily	Cumulative	
	Count	Count	Proportion	Count	Count	Proportion	Count	Count	Proportion	Count	Count	Proportion	Count	Count	Proportion
7/19	523	3,850	0.3284	11	747	0.7018	10	191	0.6633	43	174	0.2626	0	0	0.0000
7/20	89	3,939	0.3360	9	756	0.7102	5	196	0.6807	7	181	0.2732	0	0	0.0000
7/21	113	4,052	0.3456	11	767	0.7206	4	200	0.6946	3	184	0.2777	0	0	0.0000
7/22	130	4,182	0.3567	46	813	0.7638	3	203	0.7050	9	193	0.2913	0	0	0.0000
7/23	78	4,260	0.3634	8	821	0.7713	3	206	0.7154	16	209	0.3154	2	2	0.0000
7/24	305	4,565	0.3894	13	834	0.7835	3	209	0.7258	21	230	0.3471	4	6	0.0001
7/25	740	5,305	0.4525	30	864	0.8117	6	215	0.7467	50	280	0.4226	4	10	0.0002
7/26	532	5,837	0.4979	30	894	0.8399	7	222	0.7710	12	292	0.4407	7	17	0.0004
7/27	318	6,155	0.5250	4	898	0.8436	6	228	0.7918	14	306	0.4618	0	17	0.0004
7/28	738	6,893	0.5880	27	925	0.8690	7	235	0.8161	48	354	0.5343	14	31	0.0008
7/29	1020	7,913	0.6750	50	975	0.9160	6	241	0.8369	18	372	0.5614	45	76	0.0019
7/30	459	8,372	0.7141	20	995	0.9348	6	247	0.8578	5	377	0.5690	19	95	0.0023
7/31	358	8,730	0.7447	7	1,002	0.9413	4	251	0.8717	5	382	0.5765	11	106	0.0026
8/1	345	9,075	0.7741	6	1,008	0.9470	0	251	0.8717	4	386	0.5826	15	121	0.0029
8/2	283	9,358	0.7982	5	1,013	0.9517	1	252	0.8751	2	388	0.5856	15	136	0.0033
8/3	203	9,561	0.8155	4	1,017	0.9554	2	254	0.8821	0	388	0.5856	3	139	0.0034
8/4	214	9,775	0.8338	6	1,023	0.9611	5	259	0.8995	5	393	0.5931	13	152	0.0037
8/5	344	10,119	0.8631	9	1,032	0.9695	0	259	0.8995	15	408	0.6158	38	190	0.0046
8/6	403	10,522	0.8975	5	1,037	0.9742	1	260	0.9029	11	419	0.6324	102	292	0.0071
8/7	202	10,724	0.9147	4	1,041	0.9780	0	260	0.9029	5	424	0.6399	101	393	0.0096
8/8	199	10,923	0.9317	3	1,044	0.9808	8	268	0.9307	13	437	0.6595	335	728	0.0177
8/9	150	11,073	0.9445	4	1,048	0.9846	4	272	0.9446	6	443	0.6686	435	1,163	0.0283
8/10	50	11,123	0.9488	1	1,049	0.9855	0	272	0.9446	0	443	0.6686	241	1,404	0.0342
8/11	41	11,164	0.9523	2	1,051	0.9874	1	273	0.9481	3	446	0.6731	101	1,505	0.0366
8/12	55	11,219	0.9570	3	1,054	0.9902	1	274	0.9515	2	448	0.6761	268	1,773	0.0432
8/13	67	11,286	0.9627	3	1,057	0.9930	1	275	0.9550	11	459	0.6927	839	2,612	0.0636
8/14	47	11,333	0.9667	2	1,059	0.9949	0	275	0.9550	8	467	0.7048	1,621	4,233	0.1031
8/15	27	11,360	0.9690	0	1,059	0.9949	1	276	0.9585	3	470	0.7093	854	5,087	0.1239
8/16	39	11,399	0.9723	0	1,059	0.9950	5	281	0.9745	6	476	0.7186	289	5,376	0.1309
8/17	33	11,432	0.9751	0	1,059	0.9950	1	282	0.9776	12	488	0.7369	716	6,092	0.1483
8/18	27	11,459	0.9774	0	1,059	0.9953	0	282	0.9792	7	495	0.7480	439	6,531	0.1590
8/19	10	11,469	0.9782	0	1,059	0.9953	0	282	0.9792	2	497	0.7510	140	6,671	0.1624
8/20	25	11,494	0.9804	0	1,059	0.9953	1	283	0.9826	6	503	0.7600	366	7,037	0.1713
8/21	25	11,519	0.9825	0	1,059	0.9953	0	283	0.9826	18	521	0.7872	1,799	8,836	0.2151

Estimated counts based on historical data, 1991-1994 & 2002.

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APPENDIX 4.—(Page 3 of 3)

	Chum Salmon			Chinook Salmon			Sockeye Salmon			Pink Salmon			Coho Salmon		
	Daily	Cumulative		Daily	Cumulative		Daily	Cumulative		Daily	Cumulative		Daily	Cumulative	
	Count	Count	Proportion	Count	Count	Proportion	Count	Count	Proportion	Count	Count	Proportion	Count	Count	Proportion
8/22	20	11,539	0.9842	0	1,059	0.9953	1	284	0.9861	13	534	0.8068	2,341	11,177	0.2721
8/23	25	11,564	0.9864	0	1,059	0.9953	2	286	0.9931	13	547	0.8264	1,116	12,293	0.2993
8/24	20	11,584	0.9881	0	1,059	0.9953	0	286	0.9931	8	555	0.8385	690	12,983	0.3161
8/25	27	11,611	0.9904	0	1,059	0.9953	0	286	0.9931	16	571	0.8627	2,271	15,254	0.3714
8/26	30	11,641	0.9929	1	1,060	0.9962	0	286	0.9931	7	578	0.8732	4,498	19,752	0.4809
8/27	31	11,672	0.9956	1	1,061	0.9972	0	286	0.9931	15	593	0.8959	4,808	24,560	0.5980
8/28	26	11,698	0.9978	0	1,061	0.9972	0	286	0.9931	12	605	0.9140	3,416	27,976	0.6812
8/29	3	11,701	0.9980	1	1,062	0.9981	0	286	0.9931	2	607	0.9170	1,167	29,143	0.7096
8/30	5	11,706	0.9985	0	1,062	0.9981	0	286	0.9931	4	611	0.9230	401	29,544	0.7193
8/31	3	11,709	0.9987	1	1,063	0.9991	0	286	0.9931	1	612	0.9245	1,279	30,823	0.7505
9/1	3	11,712	0.9990	1	1,064	1.0000	0	286	0.9931	6	618	0.9336	1,602	32,425	0.7895
9/2	2	11,714	0.9991	0	1,064	1.0000	0	286	0.9931	4	622	0.9396	1,057	33,482	0.8152
9/3	2	11,716	0.9993	0	1,064	1.0000	1	287	0.9965	5	627	0.9472	1,181	34,663	0.8440
9/4	0	11,716	0.9993	0	1,064	1.0000	0	287	0.9965	4	631	0.9532	693	35,356	0.8609
9/5	2	11,718	0.9995	0	1,064	1.0000	0	287	0.9965	5	636	0.9608	727	36,083	0.8786
9/6	1	11,719	0.9996	0	1,064	1.0000	0	287	0.9965	3	639	0.9653	510	36,593	0.8910
9/7	0	11,719	0.9996	0	1,064	1.0000	0	287	0.9965	2	641	0.9683	850	37,443	0.9117
9/8	1	11,720	0.9997	0	1,064	1.0000	1	288	1.0000	2	643	0.9713	862	38,305	0.9327
9/9	0	11,720	0.9997	0	1,064	1.0000	0	288	1.0000	9	652	0.9849	395	38,700	0.9423
9/10	0	11,720	0.9997	0	1,064	1.0000	0	288	1.0000	4	656	0.9909	424	39,124	0.9526
9/11	2	11,722	0.9998	0	1,064	1.0000	0	288	1.0000	2	658	0.9940	477	39,601	0.9642
9/12	0	11,722	0.9998	0	1,064	1.0000	0	288	1.0000	0	658	0.9940	542	40,143	0.9774
9/13	1	11,723	0.9999	0	1,064	1.0000	0	288	1.0000	2	660	0.9970	527	40,670	0.9902
9/14	1	11,724	1.0000	0	1,064	1.0000	0	288	1.0000	2	662	1.0000	401	41,071	1.0000

APPENDIX 5.—Estimated age and sex composition of weekly chum salmon escapements through the Tuluksak River weir, Alaska, 2003, and estimated design effects of the stratified sampling design.

		Brood Year and Age Group					
		2000	1999	1998	1997	1996	
		0.2	0.3	0.4	0.5	0.6	Total
Stratum 1:	06/15 - 06/21						
No Samples Collected							
Strata 2 & 3:	06/22 - 07/05						
Sampling Dates:	07/01, 07/02, 07/04, & 07/05						
Male:	Number in Sample:	0	57	12	1	0	70
	Estimated % of Escapement:	0.0	58.2	12.2	1.0	0.0	71.4
	Estimated Escapement:	0	343	72	6	0	421
	Standard Error:	0.0	27.0	17.9	5.5	0.0	
Female:	Number in Sample:	1	18	7	2	0	28
	Estimated % of Escapement:	1.0	18.4	7.1	2.0	0.0	28.6
	Estimated Escapement:	6	108	42	12	0	169
	Standard Error:	5.5	21.2	14.1	7.7	0.0	
Total:	Number in Sample:	1	75	19	3	0	98
	Estimated % of Escapement:	1.0	76.5	19.4	3.1	0.0	100.0
	Estimated Escapement:	6	452	114	18	0	590
	Standard Error:	5.5	23.2	21.6	9.4	0.0	
Stratum 4:	07/06 - 07/12						
Sampling Dates:	07/06 - 07/10, & 07/12						
Male:	Number in Sample:	1	94	17	3	0	115
	Estimated % of Escapement:	0.5	48.5	8.8	1.5	0.0	59.3
	Estimated Escapement:	4	413	75	13	0	505
	Standard Error:	3.9	26.9	15.2	6.7	0.0	
Female:	Number in Sample:	2	71	6	0	0	79
	Estimated % of Escapement:	1.0	36.6	3.1	0.0	0.0	40.7
	Estimated Escapement:	9	312	26	0	0	347
	Standard Error:	5.4	26.0	9.3	0.0	0.0	
Total:	Number in Sample:	3	165	23	3	0	194
	Estimated % of Escapement:	1.5	85.1	11.9	1.5	0.0	100.0
	Estimated Escapement:	13	725	101	13	0	852
	Standard Error:	6.7	19.2	17.4	6.7	0.0	
Stratum 5:	07/13 - 07/19						
Sampling Dates:	07/13 - 07/15						
Male:	Number in Sample:	0	98	14	1	0	113
	Estimated % of Escapement:	0.0	49.5	7.1	0.5	0.0	57.1
	Estimated Escapement:	0	1,191	170	12	0	1,373
	Standard Error:	0.0	82.1	42.1	11.6	0.0	
Female:	Number in Sample:	2	73	8	2	0	85
	Estimated % of Escapement:	1.0	36.9	4.0	1.0	0.0	42.9
	Estimated Escapement:	24	887	97	24	0	1,033
	Standard Error:	16.4	79.2	32.3	16.4	0.0	
Total:	Number in Sample:	2	171	22	3	0	198
	Estimated % of Escapement:	1.0	86.4	11.1	1.5	0.0	100.0
	Estimated Escapement:	24	2,078	267	36	0	2,406
	Standard Error:	16.4	56.4	51.6	20.1	0.0	

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APPENDIX 5.—(Page 2 of 3)

		Brood Year and Age Group					
		2000	1999	1998	1997	1996	
		0.2	0.3	0.4	0.5	0.6	Total
Stratum 6:	07/20 - 07/26						
Sampling Dates:	07/20 - 07/22						
Male:	Number in Sample:	0	113	11	1	0	125
	Estimated % of Escapement:	0.0	60.4	5.9	0.5	0.0	66.8
	Estimated Escapement:	0	1,201	117	11	0	1,328
	Standard Error:	0.0	67.8	32.6	10.1	0.0	
Female:	Number in Sample:	2	58	2	0	0	62
	Estimated % of Escapement:	1.1	31.0	1.1	0.0	0.0	33.2
	Estimated Escapement:	21	616	21	0	0	659
	Standard Error:	14.3	64.1	14.3	0.0	0.0	
Total:	Number in Sample:	2	171	13	1	0	187
	Estimated % of Escapement:	1.1	91.4	7.0	0.5	0.0	100.0
	Estimated Escapement:	21	1,817	138	11	0	1,987
	Standard Error:	14.3	38.8	35.3	10.1	0.0	
Stratum 7:	07/27 - 08/02						
Sampling Dates:	07/27 - 07/28						
Male:	Number in Sample:	3	131	11	1	0	146
	Estimated % of Escapement:	1.5	67.5	5.7	0.5	0.0	75.3
	Estimated Escapement:	54	2,378	200	18	0	2,650
	Standard Error:	30.4	115.4	57.0	17.6	0.0	
Female:	Number in Sample:	2	45	1	0	0	48
	Estimated % of Escapement:	1.0	23.2	0.5	0.0	0.0	24.7
	Estimated Escapement:	36	817	18	0	0	871
	Standard Error:	24.9	104.0	17.6	0.0	0.0	
Total:	Number in Sample:	5	176	12	1	0	194
	Estimated % of Escapement:	2.6	90.7	6.2	0.5	0.0	100.0
	Estimated Escapement:	91	3,194	218	18	0	3,521
	Standard Error:	39.0	71.5	59.3	17.6	0.0	
Stratum 8:	08/30 - 08/09						
Sampling Dates:	08/03 & 08/04						
Male:	Number in Sample:	4	116	8	2	0	130
	Estimated % of Escapement:	2.1	62.0	4.3	1.1	0.0	69.5
	Estimated Escapement:	37	1,064	73	18	0	1,192
	Standard Error:	17.2	57.6	24.0	12.2	0.0	
Female:	Number in Sample:	3	54	0	0	0	57
	Estimated % of Escapement:	1.6	28.9	0.0	0.0	0.0	30.5
	Estimated Escapement:	28	495	0	0	0	523
	Standard Error:	14.9	53.8	0.0	0.0	0.0	
Total:	Number in Sample:	7	170	8	2	0	187
	Estimated % of Escapement:	3.7	90.9	4.3	1.1	0.0	100.0
	Estimated Escapement:	64	1,559	73	18	0	1,715
	Standard Error:	22.5	34.1	24.0	12.2	0.0	

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APPENDIX 5.—(Page 3 of 3)

		Brood Year and Age Group					
		2000	1999	1998	1997	1996	
		0.2	0.3	0.4	0.5	0.6	Total
Stratum 9:	08/10 - 08/16						
Sampling Dates:	08/10						
Male:	Number in Sample:	1	26	1	1	0	29
	Estimated % of Escapement:	2.2	57.8	2.2	2.2	0.0	64.4
	Estimated Escapement:	6	166	6	6	0	185
	Standard Error:	5.9	19.6	5.9	5.9	0.0	
Female:	Number in Sample:	1	15	0	0	0	16
	Estimated % of Escapement:	2.2	33.3	0.0	0.0	0.0	35.6
	Estimated Escapement:	6	96	0	0	0	102
	Standard Error:	5.9	18.7	0.0	0.0	0.0	
Total:	Number in Sample:	2	41	1	1	0	45
	Estimated % of Escapement:	4.4	91.1	2.2	2.2	0.0	100.0
	Estimated Escapement:	13	261	6	6	0	287
	Standard Error:	8.2	11.3	5.9	5.9	0.0	
Strata 10 - 14:	08/17 - 09/20						
No Samples Collected							
Strata 1 - 14:	06/15 - 09/20						
Sampling Dates:	06/28 - 08/10						
Male:	Number in Sample:	9	635	74	10	0	728
	% Males in Age Group:	1.3	88.2	9.3	1.1	0.0	100.0
	Estimated % of Escapement:	0.9	59.5	6.3	0.7	0	67.4
	Estimated Escapement:	102	6,755	713	85	0.0	7,655
	Standard Error:	35.6	172.6	85.1	28.4	0.0	
	Estimated Design Effects:	1.315	1.152	1.149	1.027	0.000	1.138
Female:	Number in Sample:	13	334	24	4	0	375
	% Females in Age Group:	3.5	90.0	5.5	1.0	0.0	100.0
	Estimated % of Escapement:	1.1	29.3	1.8	0.3	0	32.6
	Estimated Escapement:	131	3,331	205	36	0.0	3,703
	Standard Error:	37.5	159.9	43.0	18.2	0.0	
	Estimated Design Effects:	1.157	1.150	0.985	0.979	0.000	1.138
Total:	Number in Sample:	22	969	98	14	0	1,103
	Estimated % of Escapement:	2.0	88.8	8.1	1.1	0.0	100.0
	Estimated Escapement:	232	10,086	918	121	0	11,358 *
	Standard Error:	51.4	109.5	93.9	33.7	0.0	
	Estimated Design Effects:	1.225	1.126	1.109	1.014	0.000	

* 270 fish that were counted through the weir during stratum 1 & 10 - 14 are not included in this total.

APPENDIX 6.—Length (mm) at age for chum salmon, Tuluksak River weir, Alaska, 2003.

		Brood Year and Age Group				
		2000	1999	1998	1997	1996
		0.2	0.3	0.4	0.5	0.6
Stratum 1:	06/15 - 06/21					
No Samples Collected:						
Strata 2 & 3:	06/22 - 07/05					
Sampling Dates:	06/28, 07/01, 07/02, 07/04 & 07/05					
Male:	Mean Length		589	595	595	
	Std. Error		3	12		
	Range		530- 635	540- 675	595- 595	
	Sample Size	0	57	12	1	0
Female:	Mean Length	550	559	581	580	
	Std. Error		7	6	15	
	Range	550- 550	515- 610	560- 600	565- 595	
	Sample Size	1	18	7	2	0
Stratum 4:	07/06 - 07/12					
Sampling Dates:	07/06 - 07/12					
Male:	Mean Length	580	590	600	583	
	Std. Error		3	10	32	
	Range	580- 580	490- 715	525- 685	540- 645	
	Sample Size	1	94	17	3	0
Female:	Mean Length	510	557	585		
	Std. Error	35	4	6		
	Range	475- 545	360- 630	560- 600		
	Sample Size	2	71	6	0	0
Stratum 5:	07/13 - 07/19					
Sampling Dates:	07/13 - 07/15					
Male:	Mean Length		578	605	640	
	Std. Error		3	10		
	Range		505- 640	540- 675	640- 640	
	Sample Size	0	98	14	1	0
Female:	Mean Length	545	544	544	550	
	Std. Error	30	3	12	30	
	Range	515- 575	495- 595	500- 600	520- 580	
	Sample Size	2	73	8	2	0
Stratum 6:	07/20 - 07/26					
Sampling Dates:	07/20 - 07/22					
Male:	Mean Length		570	577	550	
	Std. Error		3	11		
	Range		475- 675	510- 640	550- 550	
	Sample Size	0	113	11	1	0
Female:	Mean Length	515	531	560		
	Std. Error	5	3	5		
	Range	510- 520	450- 600	555- 565		
	Sample Size	2	58	2	0	0

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APPENDIX 6.—(Page 2 of 2)

		Brood Year and Age Group				
		2000	1999	1998	1997	1996
		0.2	0.3	0.4	0.5	0.6
Stratum 7:	07/27 - 08/02					
Sampling Dates:	07/27 & 07/28					
Male:	Mean Length	538	554	584	565	
	Std. Error	8	3	8		
	Range	530- 555	490- 630	540- 615	565- 565	
	Sample Size	3	131	11	1	0
Female:	Mean Length	503	531	545		
	Std. Error	18	4			
	Range	485- 520	465- 570	545- 545		
	Sample Size	2	45	1	0	0
Stratum 8:	08/03 - 08/09					
Sampling Dates:	08/03 & 08/04					
Male:	Mean Length	523	559	594	650	
	Std. Error	15	3	15		
	Range	480- 550	475- 650	555- 660	650- 650	
	Sample Size	4	116	8	2	0
Female:	Mean Length	537	542			
	Std. Error	22	4			
	Range	505- 580	480- 620			
	Sample Size	3	54	0	0	0
Stratum 9:	08/10 - 08/16					
Sampling Dates:	08/10					
Male:	Mean Length	540	540	540	625	
	Std. Error		5			
	Range	540- 540	500- 620	540- 540	625- 625	
	Sample Size	1	26	1	1	0
Female:	Mean Length	490	533			
	Std. Error		7			
	Range	490- 490	495- 590			
	Sample Size	1	15	0	0	0
Strata 1 - 9:	06/15 - 08/16					
Sampling Dates:	06/28 - 08/10					
Male:	Mean Length	535	565	591	602	
	Std. Error	8	1	4	13	
	Range	480- 580	475- 715	510- 685	540- 650	
	Sample Size	9	635	74	10	0
Female:	Mean Length	522	540	559	560	
	Std. Error	10	2	6	21	
	Range	475- 580	360- 630	500- 600	520- 595	
	Sample Size	13	334	24	4	0

APPENDIX 7.—Estimated age and sex composition of weekly chinook salmon escapements through the Tuluksak River weir, Alaska, 2003, and estimated design effects of the stratified sampling design.

		Brood Year and Age Group						
		2000	1999		1998	1997	1996	
		1.1	1.2	2.2	1.3	1.4	1.5	Total
Stratum 1:	06/15 - 06/21							
No Samples Collected								
Strata 2 & 3:	06/22 - 07/05							
Sampling Dates:	06/22, 07/01, 07/02, 07/04 & 07/05							
Male:	Number in Sample:	0	23	0	20	1	0	44
	Estimated % of Escapement:	0.0	47.9	0.0	41.7	2.1	0.0	91.7
	Estimated Escapement:	0	265	0	230	12	0	506
	Standard Error:	0.0	38.4	0.0	37.9	11.0	0.0	
Female:	Number in Sample:	0	0	0	0	3	1	4
	Estimated % of Escapement:	0.0	0.0	0.0	0.0	6.3	2.1	8.3
	Estimated Escapement:	0	0	0	0	35	12	46
	Standard Error:	0.0	0.0	0.0	0.0	18.6	11.0	
Total:	Number in Sample:	0	23	0	20	4	1	48
	Estimated % of Escapement:	0.0	47.9	0.0	41.7	8.3	2.1	100.0
	Estimated Escapement:	0	265	0	230	46	12	552
	Standard Error:	0.0	38.4	0.0	37.9	21.3	11.0	
Stratum 4:	07/06 - 07/12							
Sampling Dates:	07/06 - 07/12							
Male:	Number in Sample:	0	18	0	30	1	0	49
	Estimated % of Escapement:	0.0	25.7	0.0	42.9	1.4	0.0	70.0
	Estimated Escapement:	0	22	0	36	1	0	59
	Standard Error:	0.0	1.8	0.0	2.0	0.5	0.0	
Female:	Number in Sample:	0	0	0	9	10	2	21
	Estimated % of Escapement:	0.0	0.0	0.0	12.9	14.3	2.9	30.0
	Estimated Escapement:	0	0	0	11	12	2	25
	Standard Error:	0.0	0.0	0.0	1.4	1.4	0.7	
Total:	Number in Sample:	0	18	0	39	11	2	70
	Estimated % of Escapement:	0.0	25.7	0.0	55.7	15.7	2.9	100.0
	Estimated Escapement:	0	22	0	47	13	2	84
	Standard Error:	0.0	1.8	0.0	2.1	1.5	0.7	
Stratum 5:	07/13 - 07/19							
Sampling Dates:	07/13 - 07/19							
Male:	Number in Sample:	1	9	0	5	3	0	18
	Estimated % of Escapement:	2.6	23.7	0.0	13.2	7.9	0.0	47.4
	Estimated Escapement:	3	26	0	15	9	0	53
	Standard Error:	2.4	6.3	0.0	5.0	4.0	0.0	
Female:	Number in Sample:	0	0	0	6	9	5	20
	Estimated % of Escapement:	0.0	0.0	0.0	15.8	23.7	13.2	52.6
	Estimated Escapement:	0	0	0	18	26	15	58
	Standard Error:	0.0	0.0	0.0	5.4	6.3	5.0	
Total:	Number in Sample:	1	9	0	11	12	5	38
	Estimated % of Escapement:	2.6	23.7	0.0	28.9	31.6	13.2	100.0
	Estimated Escapement:	3	26	0	32	35	15	111
	Standard Error:	2.4	6.3	0.0	6.7	6.9	5.0	

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APPENDIX 7.—(Page 2 of 3)

		Brood Year and Age Group						
		2000	1999		1998	1997	1996	
		1.1	1.2	2.2	1.3	1.4	1.5	Total
Stratum 6:	07/20 - 07/26							
Sampling Dates:	07/20, 07/21, 07/23 - 07/26							
Male:	Number in Sample:	0	2	0	11	2	0	15
	Estimated % of Escapement:	0.0	5.3	0.0	28.9	5.3	0.0	39.5
	Estimated Escapement:	0	8	0	43	8	0	58
	Standard Error:	0.0	4.6	0.0	9.4	4.6	0.0	
Female:	Number in Sample:	0	0	0	3	19	1	23
	Estimated % of Escapement:	0.0	0.0	0.0	7.9	50.0	2.6	60.5
	Estimated Escapement:	0	0	0	12	74	4	89
	Standard Error:	0.0	0.0	0.0	5.6	10.4	3.3	
Total:	Number in Sample:	0	2	0	14	21	1	38
	Estimated % of Escapement:	0.0	5.3	0.0	36.8	55.3	2.6	100.0
	Estimated Escapement:	0	8	0	54	81	4	147
	Standard Error:	0.0	4.6	0.0	10.0	10.3	3.3	
Stratum 7:	07/27 - 08/02							
Sampling Dates:	07/27 - 07/30 & 08/01							
Male:	Number in Sample:	0	5	0	6	3	0	14
	Estimated % of Escapement:	0.0	20.0	0.0	24.0	12.0	0.0	56.0
	Estimated Escapement:	0	24	0	29	14	0	67
	Standard Error:	0.0	8.6	0.0	9.2	7.0	0.0	
Female:	Number in Sample:	0	0	0	2	6	3	11
	Estimated % of Escapement:	0.0	0.0	0.0	8.0	24.0	12.0	44.0
	Estimated Escapement:	0	0	0	10	29	14	52
	Standard Error:	0.0	0.0	0.0	5.9	9.2	7.0	
Total:	Number in Sample:	0	5	0	8	9	3	25
	Estimated % of Escapement:	0.0	20.0	0.0	32.0	36.0	12.0	100.0
	Estimated Escapement:	0	24	0	38	43	14	119
	Standard Error:	0.0	8.6	0.0	10.1	10.4	7.0	
Strata 8 - 14:	08/03 - 09/20							
Sampling Dates:	08/03 - 08/05 & 08/10							
Male:	Number in Sample:	0	2	0	2	0	0	4
	Estimated % of Escapement:	0.0	33.3	0.0	33.3	0.0	0.0	66.7
	Estimated Escapement:	0	17	0	17	0	0	34
	Standard Error:	0.0	10.1	0.0	10.1	0.0	0.0	
Female:	Number in Sample:	0	0	0	0	1	1	2
	Estimated % of Escapement:	0.0	0.0	0.0	0.0	16.7	16.7	33.3
	Estimated Escapement:	0	0	0	0	9	9	17
	Standard Error:	0.0	0.0	0.0	0.0	8.0	8.0	
Total:	Number in Sample:	0	2	0	2	1	1	6
	Estimated % of Escapement:	0.0	33.3	0.0	33.3	16.7	16.7	100.0
	Estimated Escapement:	0	17	0	17	9	9	51
	Standard Error:	0.0	10.1	0.0	10.1	8.0	8.0	

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APPENDIX 7.—(Page 3 of 3)

		Brood Year and Age Group						
		2000	1999		1998	1997	1996	
		1.1	1.2	2.2	1.3	1.4	1.5	Total
Strata 1 - 14:	06/15 - 09/20							
Sampling Dates:	06/22 - 08/10							
Male:	Number in Sample:	1	59	0	74	10	0	144
	% Males in Age Group:	0.4	46.5	0.0	47.5	5.6	0.0	100.0
	Estimated % of Escapement:	0.3	33.9	0.0	34.7	4.1	0.0	72.9
	Estimated Escapement:	3	361	0	369	43	0	776
	Standard Error:	2.4	41.5	0.0	41.8	14.4	0.0	
	Estimated Design Effects:	0.617	1.710	0.000	1.732	1.259	0.000	1.003
Female:	Number in Sample:	0	0	0	20	48	13	81
	% Females in Age Group:	0.0	0.0	0.0	17.2	63.7	19.2	100.0
	Estimated % of Escapement:	0.0	0.0	0.0	4.6	17.2	5.2	27.1
	Estimated Escapement:	0	0	0	49	183	55	288
	Standard Error:	0.0	0.0	0.0	9.8	25.4	16.4	
	Estimated Design Effects:	0.000	0.000	0.000	0.632	1.080	1.299	1.003
Total:	Number in Sample:	1	59	0	94	58	13	225
	Estimated % of Escapement:	0.3	33.9	0.0	39.3	21.3	5.2	100.0
	Estimated Escapement:	3	361	0	418	227	55	1,064
	Standard Error:	2.4	41.5	0.0	42.3	27.9	16.4	
	Estimated Design Effects:	0.617	1.710	0.000	1.700	1.101	1.299	

APPENDIX 8.—Length (mm) at age for chinook salmon, Tuluksak River weir, Alaska, 2003.

		Brood Year and Age Group					
		2000	1999	1998	1998	1997	1996
		1.1	1.2	2.2	1.3	1.4	1.5
Stratum 1:	06/15 - 06/21						
No Samples Collected							
Strata 2 & 3:	06/22 - 07/05						
Sampling Dates:	06/22, 07/01, 07/02, 07/04, & 07/05						
Male:	Mean Length		532		636	710	
	Std. Error		11		21		
	Range		475- 680		490- 820	710- 710	
	Sample Size	0	23	0	18	1	0
Female:	Mean Length				760	903	930
	Std. Error				50	58	
	Range				710- 810	810-1010	930- 930
	Sample Size	0	0	0	2	3	1
Stratum 2:	07/06 - 07/12						
Sampling Dates:	07/06 - 07/12						
Male:	Mean Length		541		691	780	
	Std. Error		10		13		
	Range		445- 630		555- 825	780- 780	
	Sample Size	0	18	0	30	1	0
Female:	Mean Length				755	827	975
	Std. Error				28	19	15
	Range				620- 870	710- 900	960- 990
	Sample Size	0	0	0	9	10	2
Stratum 3:	07/13 - 07/19						
Sampling Dates:	07/13 - 07/19						
Male:	Mean Length	505	518		701	778	
	Std. Error		5		30	40	
	Range	505- 505	495- 540		595- 775	710- 850	
	Sample Size	1	9	0	5	3	0
Female:	Mean Length				764	864	911
	Std. Error				17	17	31
	Range				715- 815	760- 940	820- 960
	Sample Size	0	0	0	6	9	5
Stratum 4:	07/20 - 07/26						
Sampling Dates:	07/20, 07/21, 07/23 - 07/26						
Male:	Mean Length		528		750	833	
	Std. Error		8		24	88	
	Range		520- 535		640- 890	745- 920	
	Sample Size	0	2	0	11	2	0
Female:	Mean Length				802	868	865
	Std. Error				23	8	
	Range				765- 845	775- 925	865- 865
	Sample Size	0	0	0	3	19	1

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APPENDIX 8.—(Page 2 of 2)

		Brood Year and Age Group					
		2000	1999	1998	1998	1997	1996
		1.1	1.2	2.2	1.3	1.4	1.5
Stratum 5:	07/27 - 08/02						
Sampling Dates:	07/27 - 07/30, & 08/01						
Male:	Mean Length		536		702	842	
	Std. Error		17		38	45	
	Range		495- 590		565- 810	780- 930	
	Sample Size	0	5	0	6	3	0
Female:	Mean Length				795	894	903
	Std. Error				50	25	19
	Range				745- 845	815- 990	880- 940
	Sample Size	0	0	0	2	6	3
Strata 6 - 12:	08/03 - 09/20						
Sampling Dates:	08/03 - 08/05, & 08/10						
Male:	Mean Length		573		673		
	Std. Error		23		18		
	Range		550- 595		655- 690		
	Sample Size	0	2	0	2	0	0
Female:	Mean Length					830	870
	Std. Error						
	Range					830- 830	870- 870
	Sample Size	0	0	0	0	1	1
Strata 1 - 12:	06/22 - 09/20						
Sampling Dates:	06/22 - 08/10						
Male:	Mean Length	505	534		667	792	
	Std. Error		8		13	33	
	Range	505- 505	445- 680		490- 890	710- 930	
	Sample Size	1	59	0	72	10	0
Female:	Mean Length				772	874	906
	Std. Error				18	13	17
	Range				620- 870	710-1010	820- 990
	Sample Size	0	0	0	22	48	13

APPENDIX 9.—Daily sockeye, pink, and coho salmon counts at the Tuluksak River weir, Alaska, 1991-1994, and 2001-2003.

	Sockeye Salmon							(% passage)	Pink Salmon				(% passage)	Coho Salmon							(% passage)
Date	1991	1992	1993	1994	2001	2002	2003	(91-94 & 02)[a]	1991	1993	2001	2003	(91-94 & 02)[a]	1991	1992	1993	1994	2001	2002	2003	(91-94 & 02)[a]
6/10						0													0		
6/11						0													0		
6/12	0			0		0													0		
6/13	0			0		0													0		
6/14	0			0		0			0					0					0		
6/15	0			0		0			0					0					0		
6/16	0			0		0	0		0			0		0					0	0	
6/17	0			0		0	0		0			0		0					0	0	
6/18	0		0	0		0	0		0	0		0		0		0			0	0	
6/19	0		0	0		0	0		0	0		0		0		0			0	0	
6/20	0		0	0		0	0		0	0		0		0		0			0	0	
6/21	0		0	0		0	0		0	0		0		0		0			0	0	
6/22	0		0	0		0	0		0	0		0		0		0			0	0	
6/23	0		0	0		0	0		0	0		0		0		0			0	0	
6/24	0	0	0	0		0	0		0	0		0		0	0	0			0	0	
6/25	0	0	0	0		0	0		0	0		0		0	0	0			0	0	
6/26	0	0	0	0		1	0		0	0		0		0	0	0			0	0	
6/27	0	0	0	0		2	0		0	0		0		0	0	0			0	0	
6/28	0	0	0	0		0	0		0	0		0		0	0	0	0		0	0	
6/29	0	0	0	0	0	0	0		0	0	0	0		0	0	0	0	0	0	0	
6/30	0	0	0	0	0	0	1		0	0	0	0		0	0	0	0	0	0	0	
7/1	0	0	0	0	0	1	0		0	0	0	0		0	0	0	0	0	0	0	
7/2	0	0	0	0	0	0	1		0	0	0	0		0	0	0	0	0	0	0	
7/3	0	0	1	0	0	0	1		0	0	0	0		0	0	0	0	0	0	0	
7/4	0	0	0	0	0	0	3		0	0	0	0		0	0	0	0	0	0	0	
7/5	0	0	0	0	0	12	4		0	0	0	0		0	0	0	0	0	0	0	
7/6	0	0	0	0	0	15	0		1	0	0	0		0	0	0	0	0	0	0	
7/7	0	0	0	0	0	6	4		0	0	0	0		0	0	0	0	0	0	0	
7/8	0	0	0	0	0	0	14		0	0	0	1		0	0	0	0	0	0	0	
7/9	0	0	0	0	0	1	30		1	0	0	0		0	0	0	0	0	0	0	
7/10	0	2	4	2	0	1	6		3	0	0	0		0	0	0	0	0	0	0	
7/11	1	1	4	0	2	0	18		1	0	0	1		0	0	0	0	0	0	0	
7/12	2	0	2	0	2	0	26		5	0	0	3		0	0	0	0	0	0	0	
7/13	0	0	2	0	3	0	10		1	3	0	22		0	0	0	0	0	0	0	
7/14	0	2	4	0	2	6	25		2	1	0	13		0	0	0	0	0	0	0	
7/15	0	0	1	0	6	3	5		2	0	0	7		0	0	0	0	0	0	0	
7/16	0	4	1	0	11	4	13		2	1	0	15		0	0	0	0	0	0	0	

Estimated escapement during 1994 & 2001

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Date	Sockeye Salmon 1991	1992	1993	1994	2001	2002	2003	(% passage) (91-94 & 02)[a]	Pink Salmon 1991	1993	2001	2003	(% passage) (91-94 & 02)[a]	Coho Salmon 1991	1992	1993	1994	2001	2002	2003	(% passage) (91-94 & 02)[a]
7/17	1	1	4	2	3	5	2		5	5	0	5		0	0	0	0	0	0	0	
7/18	5	1	3	3	12	8	18		54	3	0	64		0	0	0	0	0	0	0	
7/19	1	2	5	0	12	2	10		65	2	0	43		0	0	0	0	0	0	0	
7/20	3	2	7	1	4	0	5		59	3	0	7		0	0	0	0	0	0	0	
7/21	2	2	8	1	6	0	4		28	4	0	3		0	0	0	0	0	0	0	
7/22	1	5	0	1	2	1	3		39	3	0	9		0	0	0	0	0	0	0	
7/23	0	20	2	0	1	0	3		11	1	3	16		0	1	3	0	0	0	2	
7/24	0	22	7	6	1	0	3		7	3	2	21		0	1	1	0	0	0	4	
7/25	2	8	0	11	4	0	6		8	3	1	50		0	0	1	3	0	0	4	
7/26	0	3	3	2	2	1	7		9	9	1	12		0	1	0	7	0	0	7	
7/27	0	1	2	1	8	1	6		7	9	1	14		0	0	1	7	0	0	0	
7/28	0	6	1	3	8	0	7		1	4	0	48		0	1	1	7	2	0	14	
7/29	3	4	6	3	1	2	6		6	5	0	18		0	1	7	7	6	2	45	
7/30	1	4	2	2	1	2	6		12	8	0	5		0	4	3	14	5	2	19	
7/31	0	1	4	2	4	0	4		2	18	1	5		0	1	2	7	25	0	11	
8/1	0	4	5	1	11	0	0		3	6	5	4		0	3	4	8	38	1	15	
8/2	0	3	0	2	7	0	1		4	7	4	2		0	3	4	10	23	0	15	
8/3	0	1	0	2	3	0	2		3	4	1	0		0	2	7	20	19	3	3	
8/4	1	0	0	3	1	0	5		1	3	3	5		1	3	25	27	9	8	13	
8/5	3	1	2	3	3	0	0		5	1	1	15		2	20	22	33	8	2	38	
8/6	0	2	1	3	3	0	1		7	7	4	11		0	28	21	30	6	6	102	
8/7	0	2	1	1	3	0	0		1	10	0	5		4	21	66	14	21	7	101	
8/8	1	0	1	1	1	0	8		6	4	0	13		0	11	50	34	91	6	335	
8/9	0	0	0	2	0	0	4		5	4	0	6		3	16	111	2	31	19	435	
8/10	0	2	1	2	0	2	0		3	1	4	0		4	17	83	32	21	9	241	
8/11	0	1	1	6	0	1	1		3	3	1	3		4	42	129	44	23	46	101	
8/12	1	0	0	0	0	2	1		3	5	3	2		16	81	42	12	21	197	268	
8/13	1	0	0	1	0	0	1		0	6	0	11		19	44	42	42	216	94	839	
8/14	1	0	0	0	2	0	0		1	4	1	8		20	121	149	29	226	8	1,621	
8/15	0	0	0	2	0	1	1		0	4	2	3		2	186	117	70	1,191	61	854	
8/16	0	1	1	5	0	0	5	0	1	2	0	6	0	25	43	46	102	781	66	289	0.00704
8/17	0	2	0	0	0	0	1	0	2	4	2	12	0	26	80	67	429	1,013	103	716	0.01744
8/18	0	1	0	0	1	0	0	0	3	5	0	7	0	55	93	105	122	147	14	439	0.01068
8/19	0	1	0	3	1	0	0		0	5	0	2		66	154	137	122	1,079	160	140	
8/20	1	6	0	0	0	0	1		0	3	0	6		70	64	166	101	865	183	366	
8/21	0	1	0	0	0	2	0		1	8	1	18		89	367	358	124	753	275	1,799	

Estimated escapement during 1994 & 2001
Estimated escapement during 2003

[a] Proportions for day missed.
Estimates were made using historical percent passage data from previous years with complete data.

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APPENDIX 9.—(Page 3 of 3)

	Sockeye Salmon							(% passage) (91-94 & 02)[a]	Pink Salmon				(% passage) (91-94 & 02)[a]	Coho Salmon							(% passage) (91-94 & 02)[a]
Date	1991	1992	1993	1994	2001	2002	2003		1991	1993	2001	2003		1991	1992	1993	1994	2001	2002	2003	
8/22	0	2	0	1	1	0	1		0	2	0	13		42	529	342	225	885	1,131	2,341	
8/23	0	0	0	1	0	0	2		0	8	1	13		59	318	199	601	918	415	1,116	
8/24	0	0	0	1	0	0	0		0	1	0	8		52	101	143	363	520	248	690	
8/25	1	1	0	0	1	0	0		1	4	0	16		380	420	211	807	1,572	777	2,271	
8/26	0	0	0	0	0	0	0		0	3	0	7		139	246	396	319	873	1,011	4,498	
8/27	0	0	1	0	0	0	0		0	2	0	15		79	647	504	584	754	406	4,808	
8/28	0	0	1	0	0	0	0		0	2	2	12		0	902	221	584	733	401	3,416	
8/29	0	1	0	0	0	0	0		0	1	3	2		1	448	227	346	1,309	139	1,167	
8/30	0	0	0	0	0	0	0		0	2	0	4		135	557	406	489	684	87	401	
8/31	0	0	0	0	0	0	0		0	1	0	1		150	161	617	380	653	59	1,279	
9/1	0	3	0	1	0	0	0		2	0	0	6		149	174	545	352	430	633	1,602	
9/2	0	0	0	0	0	0	0		0	2	0	4		165	922	620	107	1,463	68	1,057	
9/3	0	1	0	0	0	0	1		0	1	0	5		193	199	1,274	101	1,389	24	1,181	
9/4	0	1	0	0	0	0	0		0	0	0	4		356	105	247	183	851	133	693	
9/5	0	0	0	0	0	0	0		0	0	0	5		389	236	134	266	978	2,409	727	
9/6	0	1	0	0	0	0	0		0	0	0	3		898	84	70	212	1,422	1,329	510	
9/7	0	0	0	0	0	0	0		0	0	0	2		312	18	171	109	616	418	850	
9/8	0	0	0	0	0	0	1		0	0	0	2		180	1	70	273	485	274	862	
9/9	0	0	0	0	0	0	0		0	0	0	9		157	8	90	47	362	156	395	
9/10	1	0	0	1	1	0	0		3	0	0	4		98	16	71	42	251	97	424	
9/11	0			0			0		0			2		40			103			477	
9/12	0						0		1			0		59						542	
9/13	0						0		1			2		45						527	
9/14	0						0		0			2		35						401	
9/15	0								0					20							
9/16	1								0					29							
9/17	0								0					59							
9/18	0								1					24							
Total	34	129	88	82	137	82	288	% Missed 0.02067	392	210	48	663	% Missed 0.03861	4651	7501	8328	7952	23,768	11,487	41,071	% Missed 0.03516

Estimated escapement during 1994 & 2001

[a] Proportions for day missed.

Estimates were made using historical percent passage data from previous years with complete data.

APPENDIX 10.—Estimated age and sex composition of weekly sockeye salmon escapements through the Tuluksak River weir, Alaska, 2003, and estimated design effects of the stratified sampling design.

		Brood Year and Age Group					
		2000	1999	1998	1997	1996	
		0.3	1.2	1.3	1.4	2.3	Total
Strata 1 & 2 : 06/15 - 06/28							
No Samples Collected							
Stratum 3: 06/29 - 07/05							
Sampling Dates: 07/02, 07/04 & 07/05							
Male:	Number in Sample:	0	0	1	0	0	1
	Estimated % of Escapement:	0.0	0.0	20.0	0.0	0.0	20.0
	Estimated Escapement:	0	0	2	0	0	2
	Standard Error:	0.0	0.0	1.4	0.0	0.0	
Female:	Number in Sample:	0	0	4	0	0	4
	Estimated % of Escapement:	0.0	0.0	80.0	0.0	0.0	80.0
	Estimated Escapement:	0	0	8	0	0	8
	Standard Error:	0.0	0.0	1.4	0.0	0.0	
Total:	Number in Sample:	0	0	5	0	0	5
	Estimated % of Escapement:	0.0	0.0	100.0	0.0	0.0	100.0
	Estimated Escapement:	0	0	10	0	0	10
	Standard Error:	0.0	0.0	0.0	0.0	0.0	
Stratum 4: 07/06 - 07/12							
Sampling Dates: 07/08 & 07/12							
Male:	Number in Sample:	0	0	2	0	0	2
	Estimated % of Escapement:	0.0	0.0	22.2	0.0	0.0	22.2
	Estimated Escapement:	0	0	22	0	0	22
	Standard Error:	0.0	0.0	13.7	0.0	0.0	
Female:	Number in Sample:	0	1	6	0	0	7
	Estimated % of Escapement:	0.0	11.1	66.7	0.0	0.0	77.8
	Estimated Escapement:	0	11	65	0	0	76
	Standard Error:	0.0	10.4	15.6	0.0	0.0	
Total:	Number in Sample:	0	1	8	0	0	9
	Estimated % of Escapement:	0.0	11.1	88.9	0.0	0.0	100.0
	Estimated Escapement:	0	11	87	0	0	98
	Standard Error:	0.0	10.4	10.4	0.0	0.0	
Stratum 5: 07/13 - 07/19							
Sampling Dates: 07/13, 07/14 & 07/19							
Male:	Number in Sample:	0	2	7	2	0	11
	Estimated % of Escapement:	0.0	11.8	41.2	11.8	0.0	64.7
	Estimated Escapement:	0	10	34	10	0	54
	Standard Error:	0.0	6.0	9.1	6.0	0.0	
Female:	Number in Sample:	0	0	6	0	0	6
	Estimated % of Escapement:	0.0	0.0	35.3	0.0	0.0	35.3
	Estimated Escapement:	0	0	29	0	0	29
	Standard Error:	0.0	0.0	8.8	0.0	0.0	
Total:	Number in Sample:	0	2	13	2	0	17
	Estimated % of Escapement:	0.0	11.8	76.5	11.8	0.0	100.0
	Estimated Escapement:	0	10	63	10	0	83
	Standard Error:	0.0	6.0	7.8	6.0	0.0	

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APPENDIX 10.—(Page 2 of 2)

		Brood Year and Age Group					
		1999		1998	1997		
		0.3	1.2	1.3	1.4	2.3	Total
Stratum 6:	07/20 - 07/26						
Sampling Dates:	07/20 - 07/24						
Male:	Number in Sample:	0	0	2	0	0	2
	Estimated % of Escapement:	0.0	0.0	22.2	0.0	0.0	22.2
	Estimated Escapement:	0	0	7	0	0	7
	Standard Error:	0.0	0.0	3.8	0.0	0.0	
Female:	Number in Sample:	0	0	5	2	0	7
	Estimated % of Escapement:	0.0	0.0	55.6	22.2	0.0	77.8
	Estimated Escapement:	0	0	17	7	0	24
	Standard Error:	0.0	0.0	4.6	3.8	0.0	
Total:	Number in Sample:	0	0	7	2	0	9
	Estimated % of Escapement:	0.0	0.0	77.8	22.2	0.0	100.0
	Estimated Escapement:	0	0	24	7	0	31
	Standard Error:	0.0	0.0	3.8	3.8	0.0	
Stratum 7:	07/27 - 08/02						
Sampling Dates:	07/27 & 07/28						
Male:	Number in Sample:	0	0	1	0	0	1
	Estimated % of Escapement:	0.0	0.0	33.3	0.0	0.0	33.3
	Estimated Escapement:	0	0	10	0	0	10
	Standard Error:	0.0	0.0	9.5	0.0	0.0	
Female:	Number in Sample:	0	0	2	0	0	2
	Estimated % of Escapement:	0.0	0.0	66.7	0.0	0.0	66.7
	Estimated Escapement:	0	0	20	0	0	20
	Standard Error:	0.0	0.0	9.5	0.0	0.0	
Total:	Number in Sample:	0	0	3	0	0	3
	Estimated % of Escapement:	0.0	0.0	100.0	0.0	0.0	100.0
	Estimated Escapement:	0	0	30	0	0	30
	Standard Error:	0.0	0.0	0.0	0.0	0.0	
Strata 8 - 14:	08/03 - 09/20						
No Samples Collected							
Strata 1 - 15:	06/15 - 09/20						
Sampling Dates:	07/02 - 07/28						
Male:	Number in Sample:	0	2	13	2	0	17
	% Males in Age Group:	0.0	10.3	79.3	10.3	0.0	100.0
	Estimated % of Escapement:	0.0	3.9	29.7	3.9	0.0	37.4
	Estimated Escapement:	0	10	75	10	0	94
	Standard Error:	0.0	6.0	19.4	6.0	0.0	
	Estimated Design Effects:	0.000	0.794	1.383	0.794	0.000	1.216
Female:	Number in Sample:	0	1	23	2	0	26
	% Females in Age Group:	0.0	6.9	88.7	4.4	0.0	100.0
	Estimated % of Escapement:	0.0	4.3	55.5	2.7	0.0	62.6
	Estimated Escapement:	0	11	140	7	0	158
	Standard Error:	0.0	10.4	20.8	3.8	0.0	
	Estimated Design Effects:	0.000	1.897	1.336	0.516	0.000	1.216
Total:	Number in Sample:	0	3	36	4	0	43
	Estimated % of Escapement:	0.0	8.2	85.2	6.6	0.0	100.0
	Estimated Escapement:	0	21	215	17	0	252 *
	Standard Error:	0.0	12.0	13.6	7.1	0.0	
	Estimated Design Effects:	0.000	1.435	1.137	0.701	0.000	

* 30 fish that were counted through the weir during strata 1, 2 and 8 - 14 are not included in this total.

APPENDIX 11.—Length (mm) at age for sockeye salmon, Tuluksak River weir, Alaska, 2003.

		Brood Year and Age Class				
		1999		1998	1997	
		0.3	1.2	1.3	1.4	2.3
Strata 1 & 2:	06/15 - 06/28					
No Samples Collected						
Stratum 3:	06/29 - 07/05					
Sampling Dates:	07/02, 07/04 & 07/05					
Male:	Mean Length			590		
	Std. Error					
	Range			590- 590		
	Sample Size	0	0	1	0	0
Female:	Mean Length			559		
	Std. Error			9		
	Range			545- 585		
	Sample Size	0	0	4	0	0
Stratum 4:	07/06 - 07/12					
Sampling Dates:	07/08 & 07/12					
Male:	Mean Length			595		
	Std. Error			5		
	Range			590- 600		
	Sample Size	0	0	2	0	0
Female:	Mean Length		555	550		
	Std. Error			5		
	Range		555- 555	535- 565		
	Sample Size	0	1	6	0	0
Stratum 5:	07/13 - 07/19					
Sampling Dates:	07/13, 07/14 & 07/19					
Male:	Mean Length		558	586	635	
	Std. Error		33	7	10	
	Range		525- 590	560- 610	625- 645	
	Sample Size	0	2	7	2	0
Female:	Mean Length			553		
	Std. Error			9		
	Range			510- 580		
	Sample Size	0	0	6	0	0
Stratum 6:	07/20 - 07/26					
Sampling Dates:	07/20 - 07/24					
Male:	Mean Length			610		
	Std. Error			15		
	Range			595- 625		
	Sample Size	0	0	2	0	0
Female:	Mean Length			516	583	
	Std. Error			25	8	
	Range			430- 580	575- 590	
	Sample Size	0	0	5	2	0

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APPENDIX 11.—(Page 2 of 2)

		Brood Year and Age Class				
		1999		1998	1997	
		0.3	1.2	1.3	1.4	2.3
Stratum 7:	07/27 - 08/02					
Sampling Dates:	07/27 & 07/28					
Male:	Mean Length			600		
	Std. Error					
	Range			600- 600		
	Sample Size	0	0	1	0	0
Female:	Mean Length			528		
	Std. Error			8		
	Range			520- 535		
	Sample Size	0	0	2	0	0
Strata 1 - 7:	06/29 - 08/02					
Sampling Dates:	07/02 - 07/28					
Male:	Mean Length		558	593	635	
	Std. Error		33	5	10	
	Range		525- 590	560- 625	625- 645	
	Sample Size	0	2	13	2	0
Female:	Mean Length		555	544	583	
	Std. Error			4	8	
	Range		555- 555	430- 585	575- 590	
	Sample Size	0	1	23	2	0

APPENDIX 12.—Estimated age and sex composition of weekly coho salmon escapements through the Tuluksak River weir, Alaska, 2003, and estimated design effects of the stratified sampling design.

		Brood Year and Age Group				
		2000	1999	1998		
		1.1	2.1	2.2	3.1	Total
Strata 1 - 6:	06/15 - 06/21					
No Samples Collected						
Stratum 7:	07/27 - 08/02					
Sampling Dates:	07/28 & 07/29					
Male:	Number in Sample:	0	2	0	0	2
	Estimated % of Escapement:	0.0	33.3	0.0	0.0	33.3
	Estimated Escapement:	0	40	0	0	40
	Standard Error:	0.0	24.4	0.0	0.0	
Female:	Number in Sample:	0	4	0	0	4
	Estimated % of Escapement:	0.0	66.7	0.0	0.0	66.7
	Estimated Escapement:	0	79	0	0	79
	Standard Error:	0.0	24.4	0.0	0.0	
Total:	Number in Sample:	0	6	0	0	6
	Estimated % of Escapement:	0.0	100.0	0.0	0.0	100.0
	Estimated Escapement:	0	119	0	0	119
	Standard Error:	0.0	0.0	0.0	0.0	
Stratum 8:	08/03 - 08/09					
Sampling Dates:	08/03 - 08/05					
Male:	Number in Sample:	0	3	0	0	3
	Estimated % of Escapement:	0.0	42.9	0.0	0.0	42.9
	Estimated Escapement:	0	440	0	0	440
	Standard Error:	0.0	206.8	0.0	0.0	
Female:	Number in Sample:	0	4	0	0	4
	Estimated % of Escapement:	0.0	57.1	0.0	0.0	57.1
	Estimated Escapement:	0	587	0	0	587
	Standard Error:	0.0	206.8	0.0	0.0	
Total:	Number in Sample:	0	7	0	0	7
	Estimated % of Escapement:	0.0	100.0	0.0	0.0	100.0
	Estimated Escapement:	0	1,027	0	0	1,027
	Standard Error:	0.0	0.0	0.0	0.0	
Stratum 9:	08/10 - 08/16					
Sampling Dates:	08/10					
Male:	Number in Sample:	0	24	0	2	26
	Estimated % of Escapement:	0.0	51.1	0.0	4.3	55.3
	Estimated Escapement:	0	2,004	0	167	2,171
	Standard Error:	0.0	287.5	0.0	116.1	
Female:	Number in Sample:	0	18	0	3	21
	Estimated % of Escapement:	0.0	38.3	0.0	6.4	44.7
	Estimated Escapement:	0	1,503	0	250	1,753
	Standard Error:	0.0	279.6	0.0	140.6	
Total:	Number in Sample:	0	42	0	5	47
	Estimated % of Escapement:	0.0	89.4	0.0	10.6	100.0
	Estimated Escapement:	0	3,507	0	417	3,924
	Standard Error:	0.0	177.3	0.0	177.3	

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		Brood Year and Age Group				
		2000	1999	1998		
		1.1	2.1	2.2	3.1	Total
Stratum 10:	08/17 - 08/23					
No Samples Collected						
Stratum 11:	08/24 - 08/30					
Sampling Dates:	08/24					
Male:	Number in Sample:	1	29	0	2	32
	Estimated % of Escapement:	1.5	42.6	0.0	2.9	47.1
	Estimated Escapement:	254	7,357	0	507	8,118
	Standard Error:	253.2	1,040.3	0.0	355.4	
Female:	Number in Sample:	1	30	0	5	36
	Estimated % of Escapement:	1.5	44.1	0.0	7.4	52.9
	Estimated Escapement:	254	7,611	0	1,268	9,133
	Standard Error:	253.2	1,044.4	0.0	549.0	
Total:	Number in Sample:	2	59	0	7	68
	Estimated % of Escapement:	2.9	86.8	0.0	10.3	100.0
	Estimated Escapement:	507	14,968	0	1,776	17,251
	Standard Error:	355.4	712.8	0.0	639.2	
Stratum 12:	08/31 - 09/06					
No Samples Collected						
Stratum 13:	09/07 - 09/13					
Sampling Dates:	09/08					
Male:	Number in Sample:	1	25	0	2	28
	Estimated % of Escapement:	1.7	43.1	0.0	3.4	48.3
	Estimated Escapement:	70	1,757	0	141	1,968
	Standard Error:	69.8	265.5	0.0	97.8	
Female:	Number in Sample:	0	30	0	0	30
	Estimated % of Escapement:	0.0	51.7	0.0	0.0	51.7
	Estimated Escapement:	0	2,109	0	0	2,109
	Standard Error:	0.0	267.9	0.0	0.0	
Total:	Number in Sample:	1	55	0	2	58
	Estimated % of Escapement:	1.7	94.8	0.0	3.4	100.0
	Estimated Escapement:	70	3,866	0	141	4,077
	Standard Error:	69.8	118.7	0.0	97.8	
Stratum 14:	09/14 - 09/20					
No Samples Collected						
Strata 1 - 15:	06/15 -09/20					
Sampling Dates:	07/28 - 09/08					
Male:	Number in Sample:	2	83	0	6	91
	% Males in Age Group:	2.5	91.1	0.0	6.4	100.0
	Estimated % of Escapement:	1.2	43.9	0.0	3.1	48.2
	Estimated Escapement:	324	11,598	0	815	12,737
	Standard Error:	262.6	1,130.8	0.0	386.4	
	Estimated Design Effects:	1.518	1.385	0.000	1.332	1.388
Female:	Number in Sample:	1	86	0	8	95
	% Females in Age Group:	1.9	87.0	0.0	11.1	100.0
	Estimated % of Escapement:	1.0	45.0	0.0	5.8	51.8
	Estimated Escapement:	254	11,889	0	1,519	13,661
	Standard Error:	253.2	1,133.2	0.0	566.7	
	Estimated Design Effects:	1.795	1.384	0.000	1.579	1.388
Total:	Number in Sample:	3	169	0	14	186
	Estimated % of Escapement:	2.2	89.0	0.0	8.8	100.0
	Estimated Escapement:	578	23,486	0	2,334	26,398 *
	Standard Error:	362.2	744.0	0.0	670.5	
	Estimated Design Effects:	1.634	1.505	0.000	1.488	

* 13,229 fish that were counted through the weir during strata 1 - 6, 10, 12 & 14 are not included in this total.

APPENDIX 13.—Length (mm) at age for coho salmon, Tuluksak River weir, Alaska, 2003.

		Brood Year and Age Group			
		2000	1999	1998	1997
		1.1	2.1	2.2	3.1
Strata 1 - 6:	06/15 - 07/26				
No Samples Collected					
Stratum 7:	07/27 - 08/02				
Sampling Dates:	07/28 & 07/29				
Male:	Mean Length	495	608		
	Std. Error		18		
	Range	495- 495	590- 625		
	Sample Size	1	2	0	0
Female:	Mean Length		551		
	Std. Error		10		
	Range		530- 580		
	Sample Size	0	4	0	0
Stratum 8:	08/03 - 08/09				
Sampling Dates:	08/03 - 08/05				
Male:	Mean Length		578		
	Std. Error		10		
	Range		560- 595		
	Sample Size	0	3	0	0
Female:	Mean Length		564		
	Std. Error		6		
	Range		555- 580		
	Sample Size	0	4	0	0
Stratum 9:	08/10 - 08/16				
Sampling Dates:	08/10				
Male:	Mean Length		574		623
	Std. Error		8		13
	Range		475- 630		610- 635
	Sample Size	0	24	0	2
Female:	Mean Length		564		575
	Std. Error		6		5
	Range		495- 600		570- 585
	Sample Size	0	18	0	3
Stratum 10:	08/24 - 08/30				
Sampling Dates:	08/24				
Male:	Mean Length	545	564		580
	Std. Error		11		15
	Range	545- 545	405- 625		565- 595
	Sample Size	1	29	0	2
Female:	Mean Length	485	565		587
	Std. Error		7		7
	Range	485- 485	465- 625		575- 610
	Sample Size	1	30	0	5

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APPENDIX 13.—(Page 2 of 2)

		Brood Year and Age Group			
		2000	1999	1998	1997
		1.1	2.1	2.2	3.1
Stratum 11:	09/07 - 09/13				
Sampling Dates:	09/08				
Male:	Mean Length	570	585		578
	Std. Error		7		23
	Range	570- 570	510- 650		555- 600
	Sample Size	1	25	0	2
Female:	Mean Length		584		
	Std. Error		7		
	Range		475- 645		
	Sample Size	0	30	0	0
Stratum 1 - 11:	07/28 - 09/13				
Sampling Dates:	07/28 - 09/08				
Male:	Mean Length	548	570		588
	Std. Error		7		10
	Range	495- 570	405- 650		555- 635
	Sample Size	3	83	0	6
Female:	Mean Length	485	568		585
	Std. Error		5		6
	Range	485- 485	465- 645		570- 610
	Sample Size	1	86	0	8